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Science and Broadcasting.

IT has been rather bitterly remarked that the most attractive feature of a wireless set is that there is no necessity to have one. Many people, indeed, hold that the violation of domestic privacy by the telephone, and more particularly by the wireless set, is a thing to be deplored; and this attitude is by no means confined to those unappreciative of the benefits science has lavished upon us. Dislike of broadcasting is frequently based upon the feeling that the public is far too prone to take its opinions and its entertainment ready-made—something to be bought and paid for as one would buy a box of cigarettes. There is good cause for this feeling. The popular Press, for example, is in many ways admirable; but it would be idle to deny that the enormous circulations of modern newspapers inevitably tend forcibly to mould and stereotype public opinion, while the very fact that they cater for the masses necessitates (or apparently necessitates) a comparatively low level of intellectual outlook. The mental indolence of much of the nation is accompanied by an emotional or æsthetic indolence in choice of amusement. Instead of amusing or entertaining themselves, many people prefer to pay to be amused, and generally select that form of amusement which involves the least effort on their own part. "I like to go to the cinema once a week," said Miss Pinnegar in "The Lost Girl". "It's instruction, you take it all in at a glance, all you need to know, and it lasts you for a week. You can get to know everything about people's actual lives from the cinema." Although cinema-goers are now much too sophisticated to imagine that the film bears any sort of relation to "people's actual lives", it yet remains true that "you take it all in at a glance", and if your amusement is solely of this soporific character, taste for intellectual pleasure cannot fail to atrophy.

Those who condemn broadcasting on such grounds as have been thus briefly indicated can surely have listened-in but seldom. Whatever may be said of certain foreign stations, the British Broadcasting Corporation has consistently and steadfastly striven at a much higher aim, and on the whole with a success that must have been as gratifying to its directors as beneficial to the nation at large. It cannot have been an easy matter to plan and to realise policies and programmes that have met with such widespread and well-merited approval, not merely from the general public but also from those best qualified to

pass a critical and considered judgment on moral, æsthetic, and cultural grounds. One of the chief difficulties lies in the varied types of listeners, many of whom are only too ready to find fault with any programme that does not coincide with their personal preferences. In a foreword to the list* of broadcast talks for September to December 1930, the Hon. Harold Nicolson describes, with his usual felicitous wit, the ideal qualities of a reasonable listener: he should be unselfish, modest, patient, and able to exercise judicious selection. "He may be a busy City magnate," says Mr. Nicolson, "and, as such, feel that his attitude towards 'Ways of Cooking Fish' is, to say the least, impersonal. But there are countless other people whose days are darkened by this problem, and for whom the voice of an instructor on the subject is the voice of a true friend." As to patience, Mr. Nicolson himself seems to have little of this virtue to exercise on the 'twiddler'—the man whose chief delight is to tune in one station after another simply for the satisfaction of having got them. While we can sympathise with Mr. Nicolson's irritation at "that impatient type of egoist", we confess to a weakness for wandering off to Langenberg, Milan, or preferably Toulouse (for the ever-flowing and inconceivably soothing voice of its announcer!) when the B.B.C. is prattling of League football results or 'Autumn ailments of the Wyandotte'.

Small grumbles often conceal a great satisfaction, and men of science must feel especially satisfied with the quality and quantity of scientific matter included in this autumn's programme. Sir James Jeans is giving six lectures on "The Stars in their Courses"; Lord Moynihan, Sir Humphry Rolleston, and others of equal eminence, are talking on the future of medicine; Dr. D. Jordan Lloyd is speaking on the possibilities of synthetic food-stuffs; and Mr. B. H. C. Matthews is dealing with the electricity in our bodies. These names and subjects by no means exhaust the scientific section of the programme, but they serve to indicate that the B.B.C. committee casts its net widely and well, and that the adult portion of our population may still, if it will, be initiated into some of the habits of scientific thought and become familiar with important aspects of scientific progress and discovery.

A study of the programme shows that the ground covered—and covered by authoritative exponents—is really very extensive, and we feel that all who are in a position to do so should make an effort to ensure that the listening public derives as much benefit as possible from the fare thus generously and intelligently spread before it. It would, for example, be attractive to arrange group discussions of such talks as those on Tuesdays at 7.25 ("A Study in Population" and "The Future of the Race") and 8 o'clock ("The Mind of a Child" and "The Stars in their Courses"); adult education societies, debating clubs, and young men and women's societies ought to welcome opportunities of this kind, particularly if someone trained in science, medicine, or psychology would take the chair and direct the discussion. Free interchange of thought and opinion upon subjects of immediate interest will always be welcomed by large numbers of people who, in the absence of such stimulus, would spend their evenings in less profitable and probably more lethargic ways. Those of us who have given semi-popular lectures on scientific topics to audiences in small provincial towns or villages will agree that the desire for knowledge, in the middle classes and better sort of working classes in particular, is refreshingly vigorous; one may, indeed, go so far as to call it pathetically vigorous, for at present it is far from likely to be adequately fulfilled. The B.B.C. lectures, properly utilised, might do much to foster this love of knowledge and to train it upon the best lines. To bring about a widespread understanding of the nature of science, in a world that owes its continued existence to science but is nevertheless dangerously ignorant of that fact, would be an achievement full of the happiest prospects for the future of civilisation.

The possibilities of broadcast talks in connexion with school work ought also to receive more consideration than appears to be the case at present, though several educational associations have sub-committees to watch the matter. There are admittedly difficulties of time-table, and the school curriculum is already overcrowded, but it would surely be of great value to boys and girls if they could listen to such lectures as those on "Keeping Fit in Everyday Life". The cost of reliable receiving sets is now so small that expense can scarcely be regarded as a serious obstacle to the general use of wireless in schools; yet we think we are right in saying that a school which will cheerfully pay several guineas to a lecturer may often be found innocent of a loud speaker. The B.B.C. has shown itself so ready to comply with reasonable requests, and so enthusiastic for the cultural advancement of the nation, that we

* Broadcast Talks, September to December 1930. (London: British Broadcasting Corporation, Savoy Hill, W.C.2.) Gratis.

can be sure it would immediately respond to any approaches made to it by those responsible for the education of children. There would certainly be an immense stimulus to school science if, say once a week, one could tune in to a lecture on some scientific subject by an expert.

The present occasion is perhaps one on which a point of more general interest may be raised. Men of science, in spite of a popular but quite fallacious belief in the contrary, are keenly concerned over speech, language, and pronunciation, and view with alarm the growth of what one can only describe as a 'broadcast accent'. Uniformity of pronunciation over the whole country may or may not be desirable, and there may be technical difficulties in transmission; but we would respectfully inquire of the B.B.C. whether the familiar phrase 'forecast of to-day's weather' must necessarily be rendered 'fahcast of ta-dess wetha', and why the final *r* in 'tar' has been removed from its rightful place to form an unlovely appendage to 'law'. E. J. HOLMYARD.

Schiaparelli's Studies of Mars.

Le opere di G. V. Schiaparelli. Pubblicate per cura della Reale Specola di Brera. Tomo 1. Pp. x+515+19 tavole. 220 lire. Tomo 2. Pp. iv+486+30 tavole. 220 lire. (Milano: Ulrico Hoepli, 1930.)

WITH the appearance of these two stately volumes, we are witnessing the erection of yet another of those literary monuments which are raised from time to time by foreign countries to the memory of their great men of science. Tycho Brahe, Galileo, and Huygens have thus been commemorated during the last few years, while Kepler is under discussion for a similar honour, and now Italy is once more adding to her laurels by undertaking the publication, in a superb edition, of the complete works of Giovanni Virginio Schiaparelli.

For some time past, a need had been felt for a reprint of certain of the works of Schiaparelli, more especially of those which by reason of their scarcity were practically unobtainable by the student, so that when this matter was brought forward by Prof. Francesco Porro on the occasion of the fourteenth congress of the Italian Society for the Advancement of Science, held at Pavia in May 1925, it was unanimously decided to undertake the publication of the complete works of Italy's greatest astronomer in an edition which should have national importance and should be modelled on the following lines:

(1) All Schiaparelli's works to be included.

(2) Writings dealing with one particular subject to be printed in immediate chronological sequence. Thus, the two first volumes now before us contain all that Schiaparelli has written about the planet Mars, while future ones will deal with his important work on the connexion between comets and meteors, his researches in ancient astronomy, and the many other scientific questions that engaged his attention.

(3) The new edition to be based on the author's own corrections and emendations, as existing in the copies of his works preserved at the Brera Observatory.

Schiaparelli's actual correspondence with scientific men, however, which was most voluminous and is now scattered throughout the pages of the world's scientific journals, will not be included in the proposed volumes, but may possibly follow later as a separate publication. That this is a wise decision on the part of the committee working on this new edition will be readily conceded when it is recalled that Schiaparelli's scientific labours are to be found in some 256 separate publications ranging over the whole domain of astronomy, both ancient and modern, not to speak of numerous papers trenching on the realms of literature and art, for he was a profound classical scholar whose versatility was without apparent limit.

Although our author's remarkable discovery so early as 1866 of the connexion between the orbits of comets and meteors—a discovery for which he was awarded the gold medal of the Royal Astronomical Society—as well as his noteworthy researches many years later on the rotation periods of Mercury and Venus, were fully equal to any of his other achievements in astronomy, introducing, as they did, wholly new and unexpected elements into our views concerning the heavenly bodies, it is unquestionably with his work on Mars that the world in general will always associate his name. Beginning his observations of the planet during the opposition of 1877, and continuing them until the opposition of 1897, Schiaparelli gave to the astronomical world the most complete description of the physical appearance of Mars that had ever been published, and it is these early studies in areography which have been chosen to form the contents of the two volumes recently issued.

Considering the great name Schiaparelli afterwards made for himself as an authority on Martian phenomena, it is interesting to read in the introduction to his first memoir on the planet's axis of rotation and topography (vol. 1, p. 11), presented to the Royal Academy of the Lincei in May 1878, that, in directing his attention to Mars during

the favourable opposition of 1877, it was by no means his intention to institute a course of regular observations of its surface, but rather to test the Merz 8½-inch refractor of the Brera Observatory, which had already proved itself so efficient in double star work, as to its suitability for planetary detail. The first results, he confesses, were anything but encouraging, for he had the misfortune to commence his observations during a difficult aspect of the planet, and it was some little time before he was able to recognise certain of the features which had been charted by Kaiser and Lockyer during the opposition of 1862. His ultimate success with these, however, as well as the general excellence of the images obtained, convinced him that, though of modest aperture, the Merz telescope was fully capable of doing good work on the planet, and, encouraged by fine weather, he decided to continue his observations, with the remarkable result which these volumes are now published to commemorate.

From the outset Schiaparelli had attacked the problem before him in a severely methodical manner, and, as this first memoir shows, the exhaustive discussion of the large number of micrometric measurements obtained enabled him to give an accurate determination of the Martian axis of rotation. This important result, coupled with the careful delineation—made on strictly geometrical principles—of the planet's physical features, formed the basis of the highly particularised maps which accompany his work, and of which he could truthfully claim (vol. 1, p. 12) that, in point of detail, they far excelled anything dealing with Martian phenomena published up to that time.

It was precisely the wealth of detail recorded, however, that moved Schiaparelli to the adoption of a brand-new nomenclature. At first he was inclined to use the topographical terminology invented by Proctor, though he soon abandoned the idea in favour of the names, now become doubly classic, taken from the geography of the ancients. Thorough classicist that he was, he tells us (vol. 1, p. 61) that as he stood working at the telescope he was reminded by the peculiar demarcation of the Martian topography of the celebrated 'diaphragm' of the Greek geographer and historian, Dicaearchus, whose Βίος τῆς Ἑλλάδος was familiar to him. The euphonious geographical terms used by the Greeks, he says, appeared at once to afford the best means of avoiding all danger of confusion with earlier Martian nomenclatures while offering an opportunity of describing fittingly the totally novel features he had observed on the planet. He modestly adds, however, that he has no desire to be taken too seriously in the matter and is willing to leave to posterity the choice of a more appropriate terminology.

The passages in these two volumes to which the reader will turn with pardonable curiosity will doubtless be those where Schiaparelli first introduces his famous canals and then describes their gemination. In the first volume he states his reasons for calling the streaks he saw *canali* (vol. 1, p. 167 *et seq.*), a word which properly signifies *channels*, but has been translated into both English and French as *canals*, thus connoting a certain degree of artificiality. He mentions the furrows and 'rills' familiar to lunar observers and then speaks of the channels of the Martian landscape, maintaining that as there are "solchi della Luna", so also may there be "canali di Marte". As regards the *gemination* of the latter, perhaps the most graphic general account of this much-debated phenomenon will be found in the long German article originally contributed to *Himmel und Erde* in 1889, and now reprinted as an introduction to the second volume (vol. 2, pp. 3-46). Our author here repeats at somewhat greater length the vivid description concerning the duplication of the canals which he had presented to the Royal Academy of the Lincei during the opposition of 1881–82, when, in anticipation of the general scepticism which he knew his statements must call forth, he had hastened to add the declaration (vol. 1, p. 386) that the observed duplicity could in no way be due to eye-strain, or any form of strabismus causing diplopia monophthalmica, considering that every precaution against ocular fatigue on his part had been duly observed.

Schiaparelli had already given such frequent proof of his careful, accurate, and conscientious work as an observer that these totally unexpected results of his were received with astonishment and incredulity. Though held to be based in some unexplained way upon actual changes, seasonal or other, taking place on the planet's surface, the appearances themselves were thought to belong to psychological optics rather than to astronomy, and a vague analogy was sought in the well-known difficulties experienced by the microscopist when working with high powers on the resolution of diatomaceous frustules. Schiaparelli himself had carefully refrained from offering any sort of explanation of the singular phenomena observed. To do so, he said (vol. 1, p. 506), would be rash beyond compare—"sarebbe una temerità senza pari!"

Whatever verdict posterity may find with regard to the interpretation placed upon these results,

there can be no doubt whatever as to the lasting value of Schiaparelli's work. In many ways he was the ideal observer, who studies not only the object observed, but also the exact circumstances, physiological as well as physical, attending the observation. He described his instruments with obvious pride, and, while not a little envious of the larger apertures possessed by other nations, he was well content to do his utmost with a smaller but first-class telescope aided by the limpid skies of Italy and his own untiring zeal. During the oppositions of 1877, 1879–1880, 1881–82, and 1884, the Merz 8½-inch refractor was used, but a start was made in May 1886 with the 18-inch instrument by the same makers, and during the opposition of 1888 this telescope was the one most generally employed. Practical observers will learn with interest that with the former instrument, to which the greatest praise is given throughout, a magnification of 322 was most frequently adopted, while a memorandum was made of the fact that a tinted eye-cap of reddish-yellow glass was found to improve definition very materially (vol. 1, pp. 235 and 244).

Judging from these two noble volumes devoted to Schiaparelli's work on Mars, adorned with his portrait and many beautifully reproduced maps and drawings, and printed, moreover, on excellent paper bearing the great man's name watermarked on the lower margin of every page, we may already form some opinion as to the splendour of the literary monument Italy is thus raising to her greatest astronomer. Such an edition as this, as well as the others mentioned at the head of this notice, cannot fail to excite our highest admiration, tempered though it may be with some degree of envy that we in England have no similar edition of the works of Newton to set beside them.

W. ALFRED PARR.

Time and its History.

The Problem of Time: an Historical and Critical Study. By Prof. J. Alexander Gunn. Pp. 460. (London: George Allen and Unwin, Ltd., 1929.) 16*s.* net.

TIME, which is considered as a necessary element of history, nay, as the very substance of history itself, has now found its own historian. In his lucid and useful book on "The Problem of Time", Prof. Gunn guides us through the slippery paths and thorny places of the mono-dimensional field of time, where the pilgrim meets many extraordinary characters. From the conflicting views of the ever-changing Heraclitus and the immutable Parmenides, to the logical acrobatics of Zeno and the majestic disquisitions of Plato and Aristotle, down to the qualitative meditations of Plotinus, he lands in the medieval conceptions of time. He is shown how Augustine turns from metaphysics to psychology and substitutes discussions on memory and anticipation for past and future; and why Aquinas emphasises the Boetian doctrine of *aevum* as a mean between time and eternity. Then he discovers that the scientific revival of the Renaissance has raised both space and time from being accidental forms or minor entities to the rank of supreme or fundamental realities of the physical world. Here Galileo, Barrow, and Newton, who gave such an importance to time in the mathematical and scientific description of the world, tower over Descartes and Spinoza, who failed to appreciate the full value of time. But soon he assists in the gigantic onslaught against Newton's theory of absolute time perpetrated with psychological and metaphysical weapons by Locke, Berkeley, and Hume, and crowned by the mathematico-philosophical criticisms of Leibniz, who proposes as an alternative his relational theory of time.

Kant, of course, is given a prominent place. In trying to reconcile Newton with Leibniz and to avoid Hume's sceptical remarks, Kant leaves physics behind for transcendental æsthetics. So the pilgrim is shown why time is nothing by itself, but only a form of our intuition, nay, our very inner sense; and how Kant's treatment of time hurls him into his famous antinomies. But while he admires the relations between space and time or between time and phenomena, he is bluntly told that Kant's doctrine of time is highly unsatisfactory and contradictory—a statement soon confirmed by a fine piece of criticism of Kant's views about time. Yet that Kant's statement of problems remained the dominating feature of subsequent thought in western Europe, is shown by the wealth of criticism and alternative theories of his successors, from Hegel and Schopenhauer to Lotze and Cassirer. "The period of Kant and his successors shows a discussion of time as percept and as concept, and a struggle between the subjective and objective viewpoints in relation to time, with increasing stress on objectivity as a feature of time. This struggle has led to the conflict on the field of contemporary metaphysics, with Bergson, on the one hand, denying the existence of objective time and mischievously equating time and our subjective awareness of it, and on the other hand the physicists and the realists

asserting its objective existence, but the physicists limited merely to an interest in its measurement" (p. 340).

The whole position of time in the hurricane stirred up by the theory of relativity is then reviewed in the important chapter on "The Physicists and the Problem of Time-Measurement". Confining himself to his rôle of historian, Prof. Gunn proposes nothing new in his exposition, but his descriptive account of the fate of time tossed between the expert hands of Poincaré, Lorentz, Einstein, Eddington, Langevin, Bergson, Cassirer, Laue, and Schlick, is remarkably illuminating. Yet in his next chapter, on "Time in Contemporary Metaphysics", the philosophical exposition he gives of the doctrines of Whitehead, Russell, and McTaggart is not very satisfactory; while Alexander, Broad, Gentile, and Guyau are very adequately and ably treated. The difficulty about Prof. Whitehead is that his own terminology is not always clear, while the evolution of his views about some fundamental elements of his doctrine often leads to confusion.

Referring to the nature of time in his concluding chapter, Prof. Gunn sketches his own views about this problem, which he distinctly considers as a metaphysical problem. "Neither psychology nor physics attempts to grasp the problem of time in its full significance; the one is merely concerned with our subjective awareness of time and the other confines itself largely to considerations of measurement" (p. 371). According to Prof. Gunn, an inquiry about the nature of time is in effect an inquiry about reality itself; and the true metaphysician must not only regard reality objectively in a way which does not interest the psychologist, but also refuse to formulate a purely mathematical concept in which all qualitative and experiential factors are omitted as unreal. "The metaphysical concept of Time is one in relation to which both the mathematical and psychological concepts can be understood after their kind, but they cannot be equated with it. They separately present a false absolute, an abstraction valid within the respective sciences in which they arise, but misleading if in itself put forward as the sole description of reality. The metaphysician is concerned with the whole" (p. 396).

So Prof. Gunn reveals to us (p. 411) that "Time is an ever-changing present, a sequence of before-and-after objectively given", "a real feature within the Universe", not creating events but created them. He explains also that the concept of time cannot be legitimately divorced from perceptual experience, but that it is bound up with reality; while the whole or total reality is timeless.

A discussion of these provoking assertions would go beyond the compass of this article. But, on the whole, one fails to discover in them any new contribution to the almost exhaustive stock of theories suggested by the protean notion of time. The historical part of the work, however, suggests one or two comments.

Prof. Gunn seems to have misconceived the scholastic views about time, eternity, and eviternity (which should be the adequate term for *Aevum*). He says in a footnote (p. 21) that the scholastics consider real time as the time marked by the events of the heavens. Now, what the scholastics consider as 'real' time, in opposition to 'ideal' time, is the duration of the created objects, including man, it being understood that without an intellect to perceive this duration, no time as such could exist. Real time, therefore, is not confined for them to the motion of heavenly bodies; and further, Aquinas acknowledges in his commentary on "De Coelo" that our description of the universe could be different if we adopted other standards and methods. It is also incorrect to assert (p. 39) that Aquinas refuses his consent to the description of eternity as "interminabilis vitæ tota simul et perfecta possessio" given by Boetius, and which is laboriously explained in quest. X., art. 1, of the "Summa Theologica". As Aquinas begins his discussion by stating the objections to what he wishes to prove, Prof. Gunn has apparently read too hastily that part of the "Summa" which refers to time, taking the objection of Aquinas for his conclusions. As regards the doctrine of eviternity, the concept is ascribed to "incorporeal and heavenly bodies" in so far as they refer exclusively to the angels, whose duration has a beginning but no end, and which is a non-perfect *tota simul*, involving, however, a 'before-and-after'.

Turning to the part played by time in science, it is to be regretted that Prof. Gunn has overlooked the momentous influence of time on the development of mathematics. The timelessness of Greek mathematics, which offered no general method of describing natural phenomena; the genial speculations of Archimedes, who gave such a prominence to time in his devices—but whose name is not mentioned in Prof. Gunn's book; the mathematical discovery of time by the moderns, in their quest to give a more adequate description of Nature; the relations between the notion of

time and the method of tangents which led to the discovery of the calculus; the ontological implications of the mathematical distinction between absolute and relative time, are some of the fundamental problems which ought to have a place in a book about the history of time. Nevertheless, Prof. Gunn must be congratulated for having opened a most fascinating path to those who cannot escape the attraction of the philosophical jungle.

THOMAS GREENWOOD.

A Century of Geography.

The Record of the Royal Geographical Society, 1830–1930. By Dr. Hugh Robert Mill. Published at the Celebration of the Society's Centenary, October 1930. Pp. xvi + 288 + 35 plates. (London: Royal Geographical Society; Edward Stanford, Ltd.; John Murray, 1930.) 10*s*.

IT was a happy choice to entrust the compilation of the record of the Royal Geographical Society's work to Dr. H. R. Mill, with his forty years' experience of the Society and many years' service on its staff. He acknowledges the valued assistance, throughout the work, of Mr. Douglas Freshfield, whose connexion with the Society runs to more than half a century. It cannot have been an easy task to know what to choose and what to omit in the record of the multifarious activities of a Society that was actively interested in practically all the journeys of exploration of its time. Dr. Mill has divided his record into periods of ten or more years, and in each period he has traced the changing fortunes of the Society, given some account of its presidents and other officials, and generally has had to rest content to gauge the work of the time by adding some account of the Society's medallists and the leaders of the expeditions which it has promoted or assisted.

The published journals, proceedings, and other works of the Society and the minute-books of the council have provided the main sources of information. There are many passages recounting heated controversies on lines of policy, told with impartiality and often with a touch of humour; and behind the story is a background of London changing its face and its habits through the years. For the later part of the century Dr. Mill has drawn on his own memories, which have enabled him to give vivid character sketches of many of the men conspicuous in the Society's history. This feature of the book will appeal to many. Some will remember H. W. Bates, the secretary from 1854 until 1892, the "shy and reticent entomologist" who developed powers of insight, judgment, tact, and organisation of a remarkable order. More will recall Sir Clements Markham, who dominated the Society for half a century, a strong but obstinate man, "never able to adjust his mind to scientific modes of thought", and full of narrow prejudices and dislikes, yet warm in friendship and zealous in furthering the interests of the Society. No name connected with the Society is remembered with more regard than that of Sir J. Scott Keltie, for many years librarian, secretary, and editor, a man of unfailing tact and invariable courtesy, and a friend as much to the humble aspirant as to the successful explorer.

Although the Society has always been concerned chiefly with exploration, and almost entirely so in its early days, the furtherance of geographical education was one of the aims of its founders. However, in 1833, three years after its foundation, its council disapproved of a request for "a small endowment" from the University of London for the foundation of a chair of geography to which the Society should have the nomination. In the long reign of Sir R. Murchison as president, from 1851 until 1870, the explorer was supreme in the interests of the Society. Murchison lionised explorers and taught London to do likewise. Thus one side of geography was popularised, but only at the cost of scientific approach. Not until the seventies of last century did other aspects of geography have warm advocates. Sir F. Galton and Mr. D. Freshfield championed a wider outlook. It was Galton who devised and carried through a scheme of school prizes awarded on examination. After sixteen years the scheme was abandoned through lack of interest on the part of schoolmasters. Mr. Freshfield persevered, and by his efforts Mr. J. S. Keltie was employed to report on geographical education in other countries. This report paved the way for the foundation of lectureships, to which the Society contributed generously, at Oxford and Cambridge. The movement at length spread to all the newer universities of England, and the universities of Scotland in time followed suit. Dr. Mill traces these developments, and he might have added that, in the provision of advanced instruction and the institution of honours schools in geography, several of the new universities anticipated Cambridge.

In his final chapter Dr. Mill takes a retrospect of the century in a review of various aspects of the Society's work. These aspects are: growth in number of fellows, finance, collections of books and maps (to which justice cannot be done in a few pages), map production by the Society, instruction

to travellers, and educational activities. An interesting historical chart shows the prosperity curve (total number of fellows) and the popularity curve (annual admissions) through the century, with the duration of each presidency and secretaryship shown. This is full of significance and repays careful study. Two chapters are added by Dr. A. R. Hinks on the Society's War work and a description of the new house which in its enlarged and completed form was opened by the Duke of York on Oct. 21. The volume is illustrated by plates, which include portraits of several of the presidents and other officials, various medals, and the different houses in which the Society has had its headquarters during the century. There is an admirably full index. R. N. R. B.

Our Bookshelf.

Asia : an Economic and Regional Geography. By Dr. L. Dudley Stamp. Pp. xx + 616. (London : Methuen and Co., Ltd., 1929.) 27*s.* 6*d.* net.

IT is not only the War, with its reconstruction of States and redrawing of frontiers, nor the readjustment of economic relations consequent on these and on the changes which even the most stable countries underwent in their industries and powers of consumption, that make a new survey of the continents necessary and welcome. During the same short period, the study and, most of all, the teaching of geography have been remodelled ; even the popular outlook on the world has become geographically orientated in a way which would amaze the pioneer teachers of the previous generation. A mass of recent publications is to hand, and needs fresh guidance if it is to be used as it deserves ; and everyone has less time for acquiring exact information which daily becomes more indispensable. A fresh compendium of the geography of Asia, therefore, arouses hopes and challenges criticism.

It is characteristic of the newer geography that it bases its exposition on the reading of maps ; and Dr. Dudley Stamp's uses of this 'geographical shorthand' to condense and clarify what he has to say are numerous and often ingenious. It is characteristic, also, that geography is regarded less as a statical presentation of what is, than as an interpretation of what has come to be. If it is not, and cannot strictly be, historical science, its method has at all events much that is akin to that of history. So the book rightly begins with an excellent account of the genesis of the continent, as a clue to its structure and physique ; in which stress is laid on the provisional quality of much that is said, and alternative explanations are fairly stated. Geography, further, is an outdoor subject : and Dr. Stamp has travelled widely, in Burma, Malaya, China and Japan, Turkey, Syria and Palestine, and parts of Asiatic Russia. These journeys make possible many vivid touches of description, and a realism of outlook which permits easy handling of a very large mass of information. Occasionally colloquial and lecture-room phrases seem to waste space ; but they certainly make the book readable in a way not common among text-books. Where an earlier writer has done justice to a topic, Dr. Stamp, very sensibly, does not hesitate to quote him. The references to literature are carefully selected, and the index is ample.

It is a good test of a book of this kind, that it improves by better acquaintance. A belated review is perhaps none the less useful, if it can certify that this test has been applied : and Dr. Stamp's "Asia" is certainly a very usable book.

Experience and Nature. By John Dewey. (Published on the Foundation established in Memory of Paul Carus.) Pp. ix + ix + 443. (London : George Allen and Unwin, Ltd., 1929.) 12*s.* 6*d.* net.

IN this brilliant and inspiring book, Prof. Dewey attempts to apply in philosophy the thought which is effective in dealing with any genuine question, from the elaborate problems of science to the practical deliberations of daily life. In his opinion, the break between the two realms is the cause of our modern intellectual perplexities and confusions. He is then led to attack the momentous problem of bridging the gap between the intellectual and moral heritage of civilisation, and the material presented to the speculative mind by science, industry, or even politics, by means of what he calls "the method of empirical naturalism".

This method accepts the point of view and conclusions of modern science, and acts like a winnowing fan on the innumerable presentations of experience. What remains after the chaff is blown to the winds is enough to inspire the mind with courage and vitality to create new ideals and values. Prof. Dewey's metaphysical construction is thus based on the conception of the instrumental nature of physical science. Yet he denies the necessity of dividing the objects of experience into a physical and an ideal world, by considering them as linked together by language and other social devices. For example, by regarding life as the link between physical nature and experience, he gives a solution of the mind-body problem which more orthodox philosophers might consider as simply ignoring the whole question. Again, art and values are taken as further proofs of the continuity between nature and experiences by being defined in a pragmatic rather than in an ontological fashion.

On the whole, Prof. Dewey's philosophy is to replace the traditional separation of nature and experience by the idea of continuity. Though refreshing and encouraging in its message, it fails, however, to satisfy our quest for a deeper knowledge of things and values. Prof. Dewey's continuity is immanent rather than transcendental in character ; so that, although he talks about philosophy all the time, he seems to leave its most critical problems outside the vividly decorated house where he pretends to perform a valid marriage between nature and experience.

The Principles of Photographic Pictorialism. By F. C. Tilney. Pp. x + 218 + 80 plates. (London: Chapman and Hall, Ltd., 1930.) 25*s.* net.

MR. TILNEY is both a painter and a photographer, but above all he is a critic whose writings on photographic subjects during the past twenty years or more have been the best informed and most understanding of any. Whilst this, his latest book, is not specially concerned with photography, in that it does not touch upon any photographic manipulations or processes, it is one that will be of the greatest assistance to all who aspire to make their use of the camera something more than an aimless snapshotting of holiday incidents. It is equally addressed to the student of art and to the lover of Nature, and to both it should bring gain in the intelligent appreciation of the pictorial aspect of their subjects.

After a brief survey of the efforts at picture making in the past and the lessons they convey to us, he goes on to consider the practical points involved in this business of pictorial presentation by photography, and finally deals with certain controversial matters on which he holds firm views that do not always coincide with those held by other photographers. Wisely he begins with a chapter of definitions of the terms used by art critics, in order that there may be no misunderstanding or ambiguity. Thence he goes on to treat of the subject, its choice and design, all the factors relating to composition, beauty of shape, and tonal effect, the last a chapter of great value. In the main his observations are based upon landscape, but separate sections are devoted to figures, genre, the nude, portraiture, and still life. The final part deals with what he terms 'problems to come', under which are included halation, colour and panchromatism, perspective (on which he holds emphatic views regarding the difference between the vision of the eye and the lens), and control in printing. The illustrations, drawn from pictures by leading photographers of all times and lands, are in themselves a notable gallery of photographic art. J. DUDLEY JOHNSTON.

Allegemeine Moorgeologie: Einführung in das Gesamtgebiet der Moorkunde. Von Kurd v. Bülow. (Handbuch der Moorkunde, herausgegeben von K. v. Bülow, Band 1.) Pp. xi + 308 + 12 Tafeln. (Berlin: Gebrüder Borntraeger, 1929.) 30 gold marks.

INTEREST in peat has developed greatly in recent years, not only on the applied side of reclamation and utilisation but also on the more purely academic side. Much of the literature on the subject has, however, been inaccessible and diffuse. A "Handbuch der Moorkunde", to appear in ten volumes, will therefore be welcomed. The general editor is K. v. Bülow, of Leba, who has written the volume under review as an introduction, which will undoubtedly appeal to a wider audience than the more specialised volumes to follow. For this reason the treatment is didactic rather than critical, the nomenclature has been simplified, and references to original papers are relatively few.

After a descriptive chapter on the petrographic classification of moors, with many analyses of different kinds of peat, the author deals with modern theories of their origin and development and then proceeds to their stratigraphical morphology and geographical distribution. A preliminary attempt at a world peat map, based on the nomenclature of the Swedish worker, v. Post, shows the close relationships of the different kinds of moor to climatic factors. For Europe there is a fair agreement with the distribution of Meyer's *N.S.* quotient (rainfall divided by absolute saturation deficit). A discussion of Scandinavian work on the division of the Quaternary period by the study of peat profiles leads to an examination of the value of moors as indexes of climatic changes in post-glacial time. This part of the book will appeal to climatologists, geologists, and others.

Simple Research Problems in Chemistry: for Junior Students. By F. Sherwood Taylor. Pp. vii + 100. (London: William Heinemann, Ltd., 1929.) 4*s.*; Answers only, 1*s.* 6*d.*

THE author holds the view that the usual practical training of chemistry students is unsatisfactory, and that "there is a marked tendency for a student to obtain a first-class degree without finding out anything at all". He proposes, as a remedy, to introduce a proportion of research into the school and university courses, so as to train students to a more scientific point of view. The benefit which students get from any practical course is largely dependent on the teacher, and it is questionable whether an unorthodox course such as is here presented would lead to any better results in the hands of a poor teacher than any other. The experiments are good, and one use of the book which suggests itself is to provide exercises for practical examinations. For senior pupils in schools who have been through the usual practical courses it will also provide scope for further work, and all teachers will find Mr. Taylor's book useful and interesting, whatever view they may take of the suitability of the course for the average student. Some of the exercises are suitable for quite advanced students.

An Introduction to the Chemistry of Plant Products. By Dr. Paul Haas and Prof. T. G. Hill. Vol. 2: *Metabolic Processes.* Second edition. Pp. viii + 220. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1929.) 10*s.* 6*d.* net.

THE second edition of this standard work has been largely rewritten and considerably amplified, particularly in the chapters dealing with those sections of plant metabolism which have been undergoing rapid expansion, such as respiration and growth. In the former case, the recent work of Meyerhof, Hill, and F. F. Blackman is combined into a unified scheme of considerable value. The rather brief section in the first edition dealing with nitrogen metabolism has also been enlarged by a detailed discussion of nitrate reduction. The authors have exercised a wise choice in their amplifications and the value of the book is greatly increased throughout.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Spectrographic Analysis of Animal Tissues.

IN NATURE of April 20, 1929 (**123**, p. 601), one of us (H. R.) described a method of spectrographic analysis of mineral and organic substances and pointed out the value of the method for biological purposes. Since then we have undertaken a survey of the animal kingdom with the purpose of detecting and analysing quantitatively those of the less common elements contained in protoplasm and its products which can be investigated by this method.

The animals, if small, are minced whole, or if sufficiently large are dissected and the separate organs minced. The material is then dried at 100° C., powdered in an agate mortar, and a weighed quantity (50 mgm.) taken and rolled in ashless filter paper. The roll is burnt in an oxy-coal gas flame in front of the slit of a quartz spectrograph, the image of the flame being focused on the slit by a quartz lens. The spectrum is recorded on a photographic plate. In the case of liquids, such as blood, 0·1 c.c. is pipetted on to a rolled filter paper, which is then burnt as described.

The method has been developed quantitatively. A standard solution has been prepared containing the various elements in known quantities. Four different volumes of this solution are burnt on filter paper and the resulting spectra photographed on each plate on which the tissue spectra are recorded. The intensity of a given line in a tissue spectrum can then be matched with the corresponding line on one of the standard spectra, and the quantity of the element concerned can consequently be deduced.

Spectrographic analysis has hitherto only been applied to animal tissues in a few isolated investigations. Yet the method is obviously of great value, for a wide survey of tissue contents can be made with a rapidity impossible with chemical methods. We have commenced our investigations with annelids (analysed whole), molluscs (separate organs studied), and a few members of other phyla. Already a number of important new facts have emerged. The most salient are the following.

Iron and copper were present in all of the 146 different spectrograms made. The wide distribution of iron in protoplasm is already known, and its functional importance has been emphasised by Keilin's work on cytochrome (*Proc. Roy. Soc.*, B, **98**, 312; 1925). Copper has previously been found in numerous animal tissues and it has at least two functions, namely, as a component of the hæmocyanin molecule, and as an essential factor in hæmoglobin synthesis (Waddell, *J. Biol. Ch.*, **84**, 115; 1929, and others). When whole animals were used for our work, it is possible that elements which appeared in the spectra were in the gut or on the skin, and, of course, in the case of molluscs, copper exists in hæmocyanin. Nevertheless, the invariable presence of iron and copper strongly suggests that these are universal constituents of protoplasm.

Manganese was found in all nineteen species of polychætes studied. It was widely distributed in the molluscs, being present, for example, in all organs of land gastropods. It was found in numerous organs of marine gastropods, but was absent from *Haliotis*. The quantity in an organ varied with locality. Manganese is known to stimulate growth of rodents (McHargue, *Am. J. Physiol.*, **77**, 245; 1926. Bertrand and Nakamura, *C. R. Ac. Sci.*, **186**, 1480; 1928). When our survey has extended further, indications may be given of other functions. Harrison and Garrett (*Proc. Roy. Soc.*, B, **99**, 241; 1926) induced melanism in Lepidoptera by manganese feeding. We do not find this element particularly associated with melanin. The spectrum of the ink sac of *Sepia* shows none, and while manganese is strong in the black body-wall of *Arion ater* (0·008 per cent of dry weight), there is even more in the colourless common genital duct.

Nickel and cobalt were present in certain tissues. Cobalt was less common than nickel, and was usually associated with a relatively high concentration of the latter. But the foot of *Haliotis* has a high nickel content (0·004 per cent) without cobalt, while the liver of *Archidoris tuberculata* contains cobalt (0·003 per cent) with no nickel. There is thus a selective absorption.

Lead and silver occur spasmodically but not infrequently. The strongest silver was in the liver and kidney of *Pinna pectinata*. Individuals and individual organs absorb these metals selectively, for unknown reasons. One human subject had silver in all organs, while two others had none. Lead was present in different organs in each of the three men. This suggests an absence of functional significance.

Cadmium was found in the livers of all the eleven individuals of *Pecten maximus* examined. They came from three different localities. This seems to be the first record of cadmium in an animal.

Lithium turned out to be very widespread in animal tissues. Rubidium is less common. Cæsium was not found. This is remarkable, since rubidium and cæsium both enter frog's muscle from a perfusion fluid (Mitchell, Wilson, and Stanton: *J. Gen. Physiol.*, **4**, 141; 1921), and cæsium is present in sea water.

Strontium was present in 17 out of 19 species of polychætes and in 51 out of 67 tissues of molluscs. Previously it was known only from the skeleton of a radiolarian and from marine shells. Barium, on the other hand, was absent.

Calcium fluoride was found in one tissue only, namely, the body wall of *Archidoris tuberculata*.

A detailed account of the work will be published shortly.

H. MUNRO FOX.
HUGH RAMAGE.

University of Birmingham, and
Ridgemont, Carrow Hill, Norwich,
Oct. 3.

Experiments on Binaural Sensations.

AT intervals during the past five years I have been attempting a survey of the various experiments which have been taken as evidence that binaural sensations with musical notes of low pitch are due to the appreciation of phase differences produced at the ears. The work grew out of some experiments with sound waves which are recorded in the *Proceedings of the Physical Society* for August 1927.

Repetition of the various experiments has driven me to the conclusion that, with the forms of apparatus used, there have been possibilities of intensity changes and I do not think that these possible alterations have been sufficiently taken account of in the interpretation of some of the published results. It is very difficult to produce the binaural sensation of change of position of the sound 'image' under conditions where it can be shown that phase differences are set up without any accompanying alterations of intensity. Changes

of intensity produced by common forms of apparatus are found, when actually measured, to be surprisingly large and may well be an important factor in producing the binaural effect.

The experiments with two valve oscillators, which have been interpreted as favouring the phase difference localisation theory, depend on the known fact that, when the frequency of one oscillator is adjusted by a tuning condenser over the range for which the sets are in unison, the phase difference of the electrical oscillations, and also of the telephone diaphragm movements, alters from 0 to π. Two telephones, energised one from each oscillator, are worn over the observer's ears and he adjusts the loudness of the sound in each ear by means of two shunts. With this arrangement the sensation of rotation can be obtained either when the two circuits are nearly but not quite in tune or when the tuning condenser has its adjustment altered within the unison range.

I have made measurements both of the amplitude of the oscillatory currents and of the amplitude of the telephone diaphragm movements under these conditions and both show changes. The variations depend on the degree of coupling between the circuits, and when the amplitude is increasing in one telephone it is decreasing in the other. Thus an intensity effect is present which will aid the sense of localisation of the sound. It is possible, moreover, to produce similar intensity variations under conditions where no phase differences are present at the ears. When this is done, the sensation produced seems very like the ordinary binaural rotation.

In experiments on binaural beats it is evident that, when this form of apparatus is used, great care must be taken to eliminate all possibility of these oscillatory current variations before any conclusions are drawn about the so-called 'subjective' beats.

When sound from one source is led by two paths of adjustable length to the two ears, again experiment shows that measurable variations of intensity may occur at the ears. It would seem therefore that, until such variations have been eliminated, this method does not give conclusive evidence in favour of phase difference as the main factor in binaural localisation.

Experiments with two tuning forks producing slow beats seem to be open to criticism along similar lines.

I think that the induced currents produced in a 'phaser' when it is used to give binaural effects must be tested also for possible intensity variations. May I ask someone who possesses such a phaser with which binaural effects have been observed, if he will allow me to borrow the instrument to make measurements of the induced currents? Experiments already made with an apparatus of this type have shown that it is not easy to introduce phase difference by moving one of the coils without producing, at the same time, changes in the magnitude of the currents.

It is hoped that full details of the experiments will be ready for publication in the next few months.

S. R. HUMBY.

The College, Winchester,
Oct. 6.

Observations on the Mechanism of Spore Formation.

DURING the investigation of a spore-bearing organism isolated from heated milk, certain morphological changes prior to sporulation were observed. The observations recorded were made upon fixed preparations stained by Moeller's spore-staining technique and by Giemsa's stain, and upon unfixed preparations stained by Nakanishi's method. The results were confirmed by dark ground examination of the living organisms.

Germination of spores takes place rapidly under suitable conditions and an actively-dividing vegetative phase ensues. In this phase the cells show dense protoplasmic contents which stain readily with the basic aniline dyes (Fig. 1, i). Later, the contents become less dense, and as the time for spore formation approaches, become distinctly granular. After thirty-six to forty-eight hours' incubation a characteristic stage may be observed in which an unstained area is lying towards one end of each cell, cutting off and isolating a definite terminal part of the cell contents (ii). This terminal portion is the potential spore and its position is fixed at this stage of the development. The remainder of the cell contents, meanwhile, have shown definite signs of contraction (iii) and finally condense to form a second body, which we have called the 'secondary granule' in order to distinguish it from the 'terminal or spore granule'. The appearance of the organism at this stage is quite characteristic (iv). It consists of a swollen, practically unstained envelope within which lie the two granules, deeply stained, one terminal in position, the other

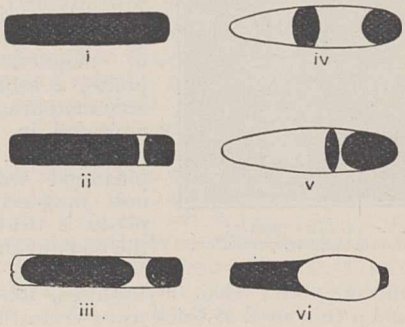

FIG. 1.

median or excentric. At a slightly later stage the position of the 'secondary granule' is seen to vary somewhat in different cells. In a definite proportion of cases, however, it is oval or lens-shaped and lies closely adjacent to the 'terminal granule' (v). Whether there is any actual contact between them has not yet been established, but it is of interest to note that it is in such cells that the first indication of a spore wall is visible, and that as soon as this wall begins to form, the staining and refractive properties of the 'spore granule' become those of a true spore. The fate of the 'secondary granule' is uncertain, but it would seem from careful observations that, having played some part in the development of the spore, it disperses throughout the body of the mother cell, which then resumes its ordinary staining capacity (vi).

A study of the literature, particularly the work of Schaudinn (1902), Guilliermond (1908), Swellengrebel (1913), Bessubetz (1913), and many others, shows that various nuclear processes have been previously recorded in connexion with spore formation. Whether any analogy exists between these findings and the present case is a point which can only be established by further and more detailed work, but there remains the strong suggestion that, as spore formation is preceded by the sequence of morphological changes recorded, some nuclear process may well be involved.

MARGARET I. CHRISTIAN.

The National Institute
for Research in Dairying,
Shinfield, nr. Reading,
Sept. 30.

Injury to Plaster due to Osmosis.

FROM time to time, it has been suggested that osmosis plays a part in the weathering of building materials. A note on a failure of plaster work for which osmotic action is directly responsible may therefore be of interest.

Brick walls are sometimes found to which lime plaster cannot be made to adhere permanently. Some time after the plaster is applied it commences to bulge and finally is pushed off the wall. Immediately behind the face of the brick is found a columnar crystalline growth which, in all cases so far examined, proves to be magnesium sulphate ($MgSO_4 7H_2O$) in a practically pure condition.

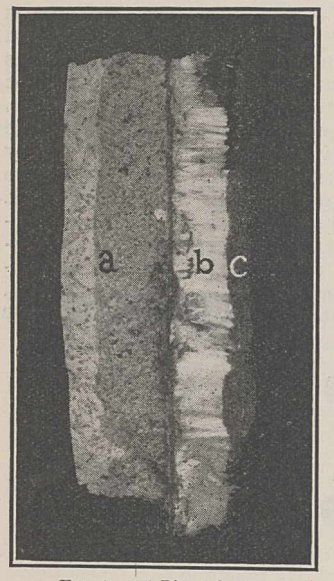

FIG. 1.—(*a*) Lime plaster; (*b*) magnesium sulphate; (*c*) brick.

It now appears that, when lime plaster is applied to bricks containing a proportion of magnesium sulphate, a semi-permeable membrane is precipitated in the face of the bricks. As the plastered wall dries out, magnesium sulphate is drawn from the body of the bricks, concentrates behind the membrane, and then crystallises, forcing the plaster and a thin shell of brick away from the wall.

It has been found possible to precipitate membranes of magnesium hydroxide in the walls of porous pots. Using a half-saturated solution of magnesium sulphate, osmotic pressures so high as 100 cm. of water were developed in three days.

In Fig. 1 is shown the magnesium sulphate growth (*b*) between the plaster (*a*) and the main body of the brick (*c*). To the left of the layer of magnesium sulphate the thin layer of brick which supports the osmotic membrane may be seen.

F. L. BRADY.

Building Research Station,
Garston, Watford, Oct. 7.

The Zeeman Effect and the Absorption Coefficients of the Hyperfine Structure Components of the Mercury Resonance Line.

THE investigations of McNair (*Phys. Review*, **31**, 986; 1928) have shown the complicated behaviour of the Zeeman patterns of the mercury resonance line, 2537 A., in emission. Some observations made in absorption five years ago by Wood appear to be in contradiction with the results of McNair. To clear up this difficulty I have made a more systematic study of the Zeeman effect of the mercury resonance line in absorption for magnetic fields from zero to 8 kilogauss and have obtained the following results:

The parallel components in absorption behave similarly to those in emission, with the exception of moderate intensities of the magnetic field, 1-3 kg., when, besides the five components, the light of intermediate wave-lengths is also absorbed. The scheme of McNair does not quite suffice to explain the behaviour of the components perpendicular to the field, because the −10·4 and +21·5 mA. components (transmitted through the absorbing vapour in the magnetic field) show for certain intensities of field an anomalous behaviour, not understandable from the point of view of McNair. However, generally speaking, the results of my investigations can be reconciled with the results of McNair rather than with the eventual existence of a Paschen-Back effect, and they lead to fairly good interpretation of the curve giving the intensity of transmitted light as a function of the field intensity, which was obtained two years ago by Schein.

These investigations have further shown that, for certain intensities of the field, the vapour transmits: (*α*) only the outer short wave-length component, −25·4 mA., or (*β*) one inner and one outer component, −10·4 and +21·5 mA., or (*γ*) two inner components, 0 and +11·5 mA. The absorption coefficients of the radiation, which was monochromatised in this way, was estimated by means of the decrease of the intensity of the resonance radiation along the beam. The measurements were made for the temperatures 0° and 16½° C. and have given the results: $\frac{\beta}{\alpha} = 1{\cdot}25$; $\frac{\gamma}{\alpha} = 1{\cdot}60$; which are in agreement with the estimates of intensity in emission lines made by Miss Schrammen. The estimated values of the absorption coefficients, which are less certain than the relative ones, computed in the ordinary way for the temperature 20° C. from the measurements made at 0° C., are: $\alpha = 3{\cdot}3$; $\beta = 4{\cdot}0$; $\gamma = 5{\cdot}1$ cm.$^{-1}$. The estimated value for all five components, $k_{20} = 4{\cdot}2$ cm.$^{-1}$, which differs only little from the average of these values, $\frac{\alpha + 2\beta + 2\gamma}{5}$, is less than that obtained from the photoelectric measurements (Kunze, Kopferman and Tietze, Zemansky), probably because I was not able to extend my measurements close enough to the window through which the exciting light enters into the resonance vessel.

A full report of these investigations will appear in the *Bulletin de l'Académie polonaise* (Cracow).

S. MROZOWSKI.

Physical Laboratory of the Society
of Sciences and Letters,
Warsaw.

Two Modifications of Liquid Ethyl Ether.

THE changes of the dielectric constant of liquid ethyl ether with temperature studied by one of us (J. M.), and described in a recent communication in NATURE, suggest that at the temperature 105·4° C. the liquid undergoes some transformations analogous to that found for liquid helium by W. Keesom and M. Wolfke (*Comm. Leiden*, 190 *b*). To confirm this supposition

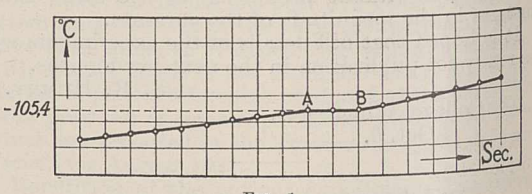

FIG. 1.

we have made a study of the change of temperature with time during the gradual heating of carefully purified ethyl ether.

Ethyl ether cooled to a temperature lower than −105·4° C. was contained in a Dewar vessel provided with a nickel covered refrigerator cooled with liquid air. We have studied the change with time of gradually increasing temperature of the ether, which was

isolated from all external disturbances. The platinum resistance thermometer was used as a stirrer.

The accompanying graph (Fig. 1) representing these observations shows a distinct slowing down of the rate of change of temperature at −105·4° C. (see the part A B of the curve). The transformation point is very clearly indicated in this heating curve. The parts of curve above and below the point −105·4° C. are to a high degree of approximation straight lines, making different angles with the temperature axis, which shows that the specific heat of ethyl ether undergoes a change at −105·4° C.

The transformation of liquid ether described above is the second observed case of such a phenomenon, the first one being the discovery of liquid helium I. and helium II. by W. Keesom and M. Wolfke (*Comm. Leiden*, 190 *b*).

M. WOLFKE.
J. MAZUR.

Physical Laboratory,
Technical Institute, Warsaw.
Sept. 30.

The Development of the Mesoderm in Gastropods.

IN 1891 Erlanger reported that in the freshwater snail *Paludina* the mesoderm was formed as a hollow pouch budded out from the primitive gut or archenteron. From a portion of this pouch, which may be regarded as the secondary body-cavity or cœlom, the pericardial sac was formed. Such a mode of the formation of the cœlom, though normal in Echinodermata and Chætognatha and also in *Amphioxus* and the Enteropneusta, was hitherto unknown in Mollusca, and Erlanger's results were received with a storm of scepticism. Later, Tönniges (1896) examined the development of *Paludina* and denied the validity of Erlanger's results, and asserted that the mesoderm arose as small cells budded from the ectoderm. The most recent worker on the subject (Dautert, 1929) has confirmed Tönniges's conclusions.

It seemed as if Erlanger had been utterly discredited. During this summer Mr. Fernando, a student working in my laboratory, re-examined *Paludina*. He found all the stages figured by Erlanger and completely confirmed his results. But he also found the stages figured by Dautert and Tönniges and showed that the differing results of these two workers were due to the old embryological error of missing out stages in development.

Fernando's results may serve as a warning against accepting negative results in zoology. Positive results are a definite addition to our knowledge: they may be misinterpreted and later workers may supply better interpretations, but negative results which suggest that positive results are entirely imaginary are almost always due to defective observation.

E. W. MACBRIDE.

Imperial College of Science,
London, S.W.7.

Vitamin A and Carotene.

RECENT work by Moore and others (see, for example, Moore, *Biochem. Jour.*, **24**, 692; 1930) has left little doubt that, in the rat, carotene can function as a precursor of vitamin A. Experiments which I have just carried out have indicated that the same holds true in the fowl also. White Leghorn chickens, six weeks old, were given a synthetic diet free from vitamin A to which irradiated ergosterol was added to supply vitamin D. Control birds receiving this diet succumbed in about six weeks, their livers giving negative tests for vitamin A either by the antimony chloride test or by the absorption spectrum. To other birds, after a preliminary period of vitamin A depletion, daily doses of carotene (1 mgm.) or cod liver oil concentrate (10 mgm.) were given, with the result that complete cures were effected and satisfactory growth restored. The livers of all these birds, receiving either carotene or concentrate, gave positive tests for vitamin A, the oils yielding an intense blue colour with antimony chloride and showing a strong absorption band in the region of 328 $\mu\mu$.

As well as indicating that the ability to transmute carotene into vitamin A may hold fairly generally throughout the animal kingdom, the experiments would seem to afford an explanation of the results of Palmer and Kempster (*Jour. Biol. Chem.*, **39**, 331; 1919), who found that while xanthophyll fed to fowl reared on a diet free from carotenoids quickly increased their pigmentation, carotene had no such effect. The transmutation of carotene into the colourless vitamin A would account for this very simply.

A full account of the experiments will be published elsewhere.

NORMAN S. CAPPER.

The Donald Currie Laboratories,
The Queen's University of Belfast.

Denaturation of Proteins by Urea.

THE important article by Sir Frederick G. Hopkins which appeared in NATURE on Aug. 30 and Sept. 6 records many valuable new observations on which he is to be congratulated. It has, indeed, only one defect, and, at his request, I write to make that good, namely, the absence of all reference to the observations made many years ago by myself and my delightful friend Dr. N. G. Chavasse, a man who was twice awarded the V.C., and whose loss is to me one of the major tragedies of the War. The fact that Sir Frederick knew nothing of these observations is, however, very intelligible, since the first paper (*Jour. of Physiol.*, **28**, pp. 23-26; 1902) appeared obscurely in the *Proceedings*, only, of the Society concerned, and the second (*Proc. Faraday Soc.*, March 1913; German translation in *Zeits. f. Kolloide*, **12**, pp. 250-252; 1913) was entitled "Graded Protein Sols".

Let me add that during the last two years Mr. J. Hatton has been working on this subject under my supervision, and that in 1929 we found, like Sir Frederick, that the rate of denaturation of approximately isoelectric egg-albumin by urea had a negative temperature coefficient. Other results of ours will now be found in the Proceedings of the Biochemical Society published in *Chemistry and Industry*, Oct. 10, 1930, p. 851. That account should be supplemented by the statement that, in the case of sheeps' wool, much, though apparently not all, of the substances the thiol or disulphide groups of which have become 'unmasked' passes into the urea solution.

W. RAMSDEN.

University of Liverpool,
Oct. 13.

Oviposition of *Hæmatopota pluvialis*, Linné.

DR. CAMERON'S interesting account, in NATURE of Oct. 18, p. 601, of the oviposition habits of Tabanid flies, and especially of those of *Hœmatopota pluvialis*, L., suggests that the following observation may be worth recording. On Aug. 24, 1925, at Waidbruck (Ponte all' Isarco), Italian Tyrol, I observed a female of *Tabanus glaucopis*, Mg., laying her eggs on the leaves of the common plantain, *Plantago lanceolata*. The plant was growing in a dry hay-field, not in the immediate vicinity of water.

O. W. RICHARDS.

Imperial College Biological Field Station,
Slough, Bucks.

The Biological Significance of Conjugate Nuclei in *Coprinus lagopus* and other Hymenomycetes.*

By Prof. A. H. REGINALD BULLER, F.R.S.

CONJUGATE nuclei are two nuclei of opposite sex, associated with one another in a single cell, which divide sumultaneously in such a way as to give rise to two daughter pairs of conjugate nuclei. Stages in conjugate nuclear division in *Coprinus lagopus*, based on the work of Mlle. Bensaude, are shown in Fig. 7.

In animals conjugate nuclei are unknown and in plants their occurrence is limited to the Higher Fungi. They especially characterise the diploid mycelium and fruit-bodies of the Hymenomycetes (Mushrooms and Toadstools) and the diploid mycelium of the Rust Fungi and the Smut Fungi, all of which groups are included in the larger assemblage of the Basidiomycetes. Conjugate nuclei

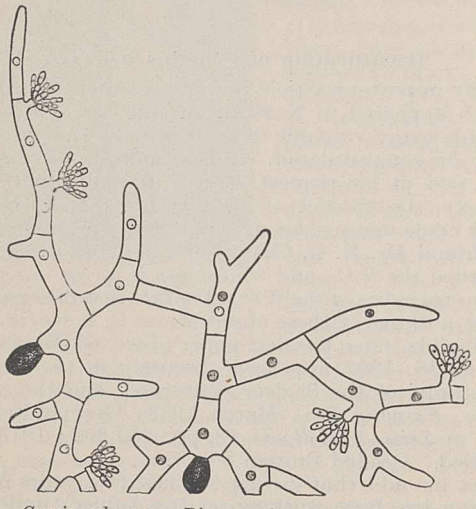

FIG. 1.—*Coprinus lagopus*. Diagram showing two *haploid* mycelia of opposite sex, (*AB*) on right (black nuclei), (*ab*) on left (white nuclei), each derived from a single basidiospore. Note the simple septa, the groups of oidia, and the isolated nuclei. The two mycelia have just effected a hyphal fusion and in the fusion cell an (*AB*) nucleus and an (*ab*) nucleus have become associated as a pair of conjugate nuclei. The diploid cell is able to diploidise all the other cells of both mycelia by a process illustrated in Fig. 6.

are also present in the ascogenous hyphæ of certain Ascomycetes.

Coprinus lagopus is a small toadstool of common occurrence on horse dung in pastures. Its pilei shed numerous black basidiospores which are carried off by the wind, settle on grass, etc., are swallowed with herbage by horses, and germinate in freshly deposited dung-balls. In these dung-balls haploid mycelia of opposite sex mate with one another and form diploid mycelia. The diploid mycelia give rise to diploid fruit-bodies which produce and liberate haploid basidiospores. The life-cycle from spore to spore is carried through in 10-14 days.

As determined by Hanna,[1] Dorothy Newton,[2] and others, the monosporous mycelia (each derived from a single basidiospore) of *Coprinus lagopus* fall into four groups. If it be assumed that each mycelium bears one of each of two pairs of sex factors, *Aa* and *Bb*, then the four groups of mycelia and the four groups of spores from which they have

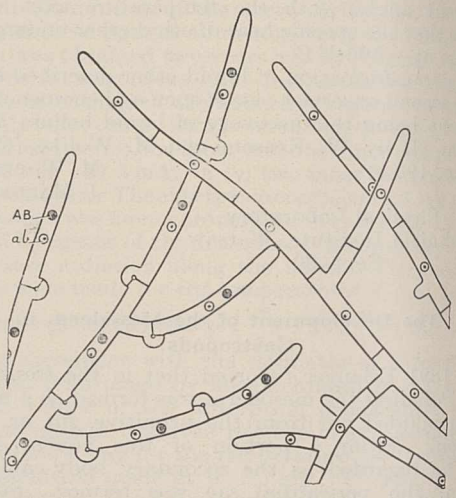

FIG. 2.—*Coprinus lagopus*. A diploid mycelium (*AB*)+(*ab*) on the left, and a haploid mycelium (*ab*) on the right. In the diploid mycelium, note the pairs of conjugate nuclei of opposite sex in each cell and the clamp-connexion at each septum. A central hypha of the diploid mycelium is about to fuse with a hypha of the haploid mycelium. The diploid mycelium, after the fusion was effected, would begin to diploidise the haploid mycelium.

been derived may be represented by the symbols (*AB*), (*ab*), (*Ab*), and (*aB*).

Successful mating of the haploid mycelia of *Coprinus lagopus* with the production of a diploid mycelium (bearing clamp-connexions and containing a conjugate pair of nuclei in each cell) is

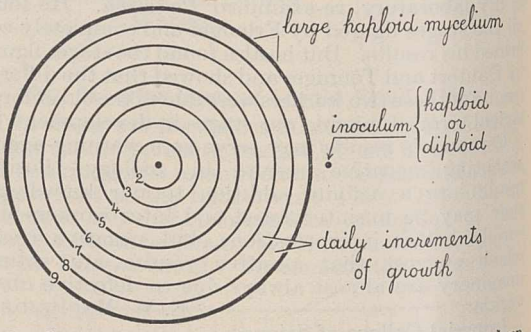

FIG. 3.—*Coprinus lagopus*. A large haploid mycelium which has been growing for 9 days on dung-agar. A tiny hyphal mass of another haploid mycelium of opposite sex or of a suitable diploid mycelium, called the *inoculum*, has just been set a little way from the periphery of the large haploid mycelium. Two-thirds the actual size.

normally possible only in the combinations (*AB*) × (*ab*) and (*Ab*) × (*aB*). These two kinds of combinations give rise to two kinds of diploid mycelia which may be represented by the symbols (*AB*)+(*ab*) and (*Ab*)+(*aB*) respectively.

Haploid mycelia (Fig. 1) are known by containing single isolated nuclei, by having simple septa devoid of clamp-connexions, by the wide-angled mode of branching of their leading hyphæ, and by bearing oidia. Diploid mycelia (Fig. 2,

* Substance of a paper communicated to a meeting of the Fifth International Botanical Congress at Cambridge, Aug. 19, 1930.

left) are known by their cells containing pairs of conjugate nuclei, by having a clamp-connexion at each septum, by the narrow-angled mode of branching of their leading hyphæ, and by not bearing oidia. Clamp-connexions, as shown by the cytological investigations of Mlle. Bensaude, Hans Kniep, and others, are the outward and visible sign that the adjacent cells are diploid in that these cells contain a pair of nuclei of opposite sex.

A large haploid mycelium (*AB*), which had been growing on a dung-agar plate for 9 days (cf. Fig. 3), was inoculated with a small hyphal mass of a haploid mycelium (*ab*). The two mycelia soon fused hyphally and mutually *diploidised* one another, that is, (*ab*) nuclei entered the mycelium (*AB*), divided and subdivided, and established pairs of conjugate nuclei (*AB*) + (*ab*) in every cell of the peripheral hyphæ of (*AB*), while (*AB*) nuclei entered the mycelium (*ab*), divided and subdivided, and established pairs of conjugate nuclei (*AB*) + (*ab*) in every cell of the peripheral hyphæ of (*ab*). This was indicated by the appearance of clamp-connexions. In the large haploid mycelium (*AB*), clamp-connexions appeared on the (*AB*) hyphæ on each side of the inoculum (*ab*) progressively (*vide* crosses in Fig. 4); and the diploidisation† of the (*AB*) mycelium was effected in the course of three days. In 42 hours after the (*ab*) inoculum had been deposited and about 40 hours after the (*ab*) and (*AB*) mycelia had come into contact with one another, clamp-connexions had appeared at a distance of 6 cm. or 60 mm. from the inoculum. Therefore (*ab*) nuclei must have moved through the hyphæ of the (*AB*) mycelium at an average rate of at least 1·5 mm. per hour. The nuclei could not move in a straight line like that shown in Fig. 4, because the mycelium (*AB*) was a three-dimensional hyphal net-work. The (*ab*) nuclei must have taken a zigzag path and, therefore, their speed of movement doubtless exceeded 2 mm. per hour. As Lehfeldt's cytological work on *Typhula erythropus* has shown,[3] the septa of a haploid mycelium undergoing diploidisation break down and thus allow nuclei to pass along the hyphæ.

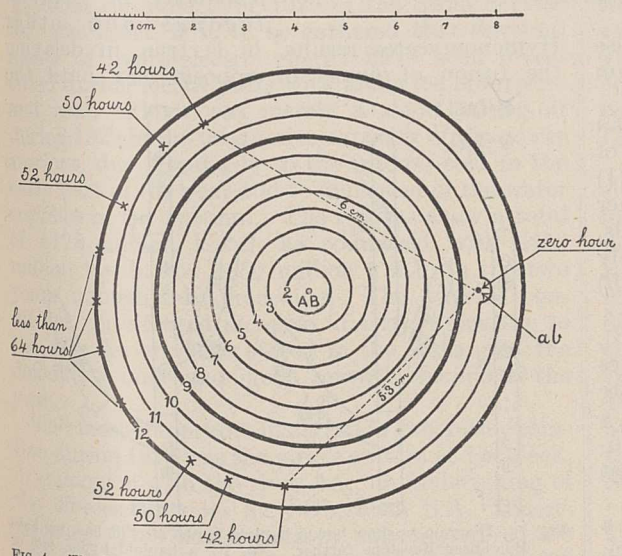

FIG. 4.—The diploidisation of a large haploid mycelium (*AB*) by another *haploid* mycelium (*ab*) of opposite sex. The circles 2-12, originally drawn in blue pencil on the under side of the Petri dish, show the boundary of the mycelium from the end of the second to the end of the twelfth day. The (*AB*) mycelium was inoculated with a tiny hyphal mass of an (*ab*) mycelium after 9 days of growth (periphery shown by heavier inner circle, No. 9) at the zero hour. The (*ab*) mycelium diploidised the (*AB*) mycelium in the course of three days. The crosses show where clamp-connexions were observed at particular times. The (*ab*) nuclei must have travelled more than 6 cm. or 60 mm. through the (*AB*) hyphæ in about 40 hours, or more than 1·5 mm. per hour. Two-thirds the actual size.

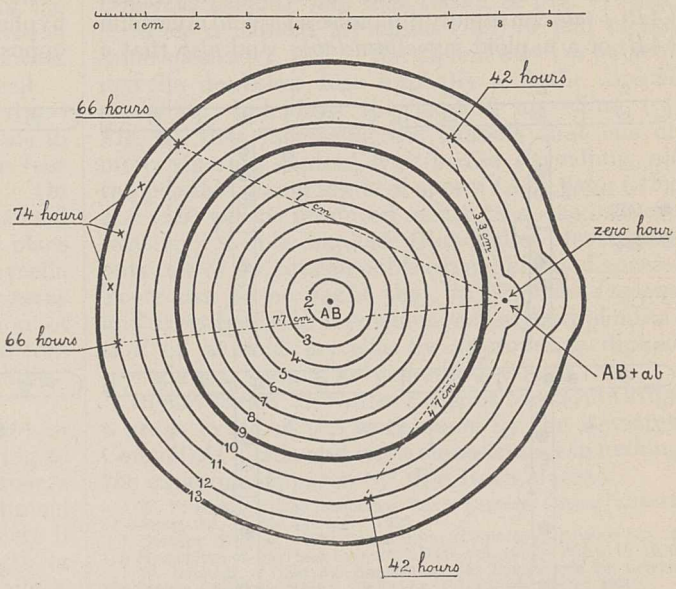

FIG. 5.—The diploidisation of a large haploid mycelium (*AB*) by a *diploid* mycelium (*AB*) + (*ab*). The (*AB*) mycelium was inoculated with a tiny hyphal mass of the (*AB*) + (*ab*) mycelium after 9 days of growth (periphery shown by heavier inner circle, No. 9) at the zero hour. The diploid mycelium diploidised the haploid mycelium in a little more than three days. The crosses show where clamp-connexions were observed at particular times. The (*ab*) nuclei must have travelled more than 7·7 cm. or 77 mm. through the (*AB*) hyphæ in about 64 hours, or more than 1·2 mm. per hour. Two-thirds the actual size.

Fig. 5 illustrates an experiment similar to that just described, except for the important fact that a *diploid* inoculum was employed instead of a haploid. The combination was a large haploid mycelium (*AB*) and a small diploid inoculum (*AB*) + (*ab*). Again the large haploid mycelium was progressively diploidised. In this case, doubtless, (*ab*) nuclei left the diploid inoculum, entered the (*AB*) mycelium, there divided and subdivided, and so provided mates

† The term *diploidisation* has been introduced here for the first time to designate the process by which a haploid cell is converted into a diploid cell or a haploid mycelium into a diploid mycelium by the formation of conjugate nuclei within the cell's or the mycelium's interior. A haploid mycelium of one sex may be said to *diploidise* a haploid mycelium of opposite sex.

to form conjugate pairs with all the (*AB*) nuclei in the peripheral hyphæ of the (*AB*) mycelium.

It has been found that a diploid mycelium (*AB*) + (*ab*) can rapidly diploidise a haploid mycelium (*AB*) or a haploid mycelium (*ab*); and also that a diploid mycelium (*Ab*) + (*aB*) can rapidly diploidise a haploid mycelium (*Ab*) or a haploid mycelium (*aB*).

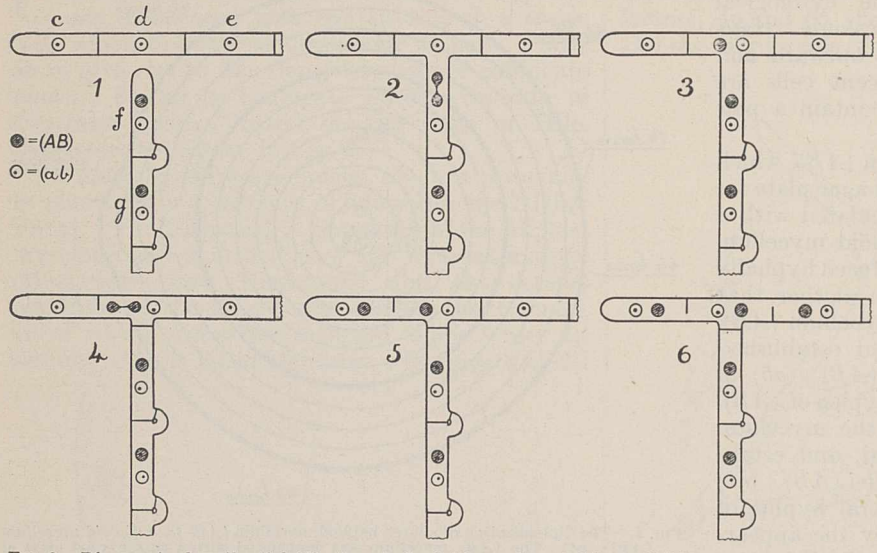

FIG. 6.—Diagram to show the diploidisation of a haploid mycelium (*ab*) by a *diploid* mycelium (*AB*) + (*ab*). No. 1: the cell *f* of the diploid hypha *fg* is growing toward, and soon will meet and fuse with, the cell *d* of the haploid hypha *cde*. No. 2: fusion has taken place and the (*AB*) nucleus of *f* is dividing. No. 3: one of the daughter (*AB*) nuclei has passed into the cell *d*, thus diploidising it. No. 4: a wall now separates the cells *d* and *f*, and the (*AB*) nucleus in the cell *d* is dividing. No. 5: the wall between the cells *c* and *d* is partly broken down and one of the daughter (*AB*) nuclei has passed through it from *d* to *c*. No. 6: the (*AB*) nucleus of the cell *d* has again divided and sent one of its daughter (*AB*) nuclei into the cell *e*. Thus the diploid cell *f* diploidised the haploid cell *d* and the diploid cell *d* in its turn diploidised first the haploid cell *c* and then the haploid cell *e*.

The discovery that a diploid mycelium can diploidise an appropriate haploid mycelium is of considerable interest from two points of view: (1) It indicates that, in *Coprinus lagopus* and other similar fungi, the normal matings in dung-balls, wood, and other substrata in Nature are not merely the haploid matings (*AB*) × (*ab*) and (*Ab*) × (*aB*) but are also the haploid-diploid matings (*AB*) × (*AB*) + (*ab*), (*ab*) × (*AB*) + (*ab*), (*Ab*) × (*Ab*) + (*aB*), and (*aB*) × (*Ab*) + (*aB*); and (2) it also indicates that a diploid cell containing a pair of conjugate nuclei can diploidise a haploid cell containing a single nucleus, and thus gives us a clue to the biological significance of conjugate nuclei. This last point will now be discussed.

When, in a haploid-diploid combination, a diploid cell containing a pair of conjugate nuclei, say (*AB*) + (*ab*), comes into contact with a haploid cell containing a single nucleus, say (*ab*), doubtless the (*AB*) nucleus—possibly in response to a stimulus received from the unpaired (*ab*) nucleus—*divides* and sends off one of the daughter nuclei into the haploid cell (Fig. 6, stages 2 and 3). Thus, in a very simple way, a diploid cell can diploidise a haploid cell. Doubtless, also, when a large haploid mycelium has been inoculated with a tiny hyphal haploid inoculum of opposite sex, the progressive diploidisation of the large haploid mycelium is due essentially to the fact that a diploid cell is able to diploidise neighbouring haploid cells in the manner just suggested (cf. Fig. 6, stages 3-6).

If, when a large haploid mycelium (*AB*) made a hyphal fusion with a small haploid inoculum of opposite sex (*ab*), an (*ab*) nucleus on passing into an (*AB*) cell immediately fused with the (*AB*) nucleus there present, an (*AaBb*) nucleus would result and progressive diploidisation of the thousands of other (*AB*) cells the (*AB*) nuclei of which awaited partners would be impossible. However, since the (*ab*) nucleus is attracted by, but does not fuse with, the first (*AB*) nucleus it meets, it is possible for it to divide and send off a daughter (*ab*) nucleus into the next haploid (*AB*) cell and thus contribute to the diploidisation process.

The organisation of the nuclei in conjugate pairs (*n*) + (*n*) instead of as isolated nuclei (2*n*) in the diploid mycelium and fruit-body of *Coprinus lagopus* and other Hymenomycetes results, it is true, in delaying the fusion of nuclei of opposite sex until the basidia come into existence, but it has the great advantage that, in the diploid mycelium or in a diploid cell of a haploid mycelium under-

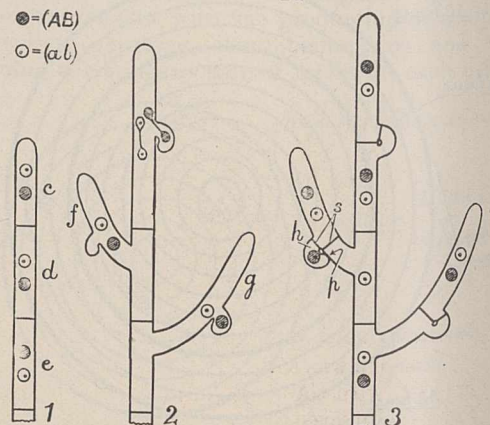

FIG. 7.—Diagram to show how a haploid hypha after it has just been diploidised develops further. No. 1: a haploid hypha (*ab*) or (*AB*) which has just been converted into a diploid hypha (*AB*) + (*ab*); a pair of conjugate nuclei are present in each cell. No. 2: the cells *d* and *e* have branched and the cell *c* has elongated; in *f* a hook has grown backwards; in *g* an (*AB*) nucleus has passed into the hook; in the terminal cell *c*, the two nuclei are dividing conjugately and the hook is growing toward the main hypha. No. 3: in the branch *f* the two daughter pairs of conjugate nuclei have separated from one another and two septa *s* have been formed, but the lower (*AB*) nucleus is momentarily a prisoner in the hook-cell *h*, from which it will escape as soon as the walls at *p* have broken down; in the branch *g* and the terminal cell *c* conjugate nuclear division and cell-division with the formation of a clamp-connexion is complete and each daughter cell contains a pair of conjugate nuclei (*AB*) and (*ab*).

going diploidisation, each member of a pair of conjugate nuclei retains its identity, so that one member of a pair can divide independently of the other member of the pair whenever such a division is able to promote the diploidisation of another haploid mycelium or of an adjacent haploid cell.

The sexual process (fertilisation or conjugation) of animals and most plants is relatively simple in that two *unicellular* and *uninucleate* gametes fuse to form a unicellular and uninuclear zygote. On the other hand, in the Hymenomycetes the sexual process is more complicated, because it takes place between *multicellular* and *multinucleate* mycelia and results in *the diploidisation of all the growing cells of each mycelium*. It is the non-fusion of nuclei of opposite sex and the establishment of conjugate pairs of nuclei which makes this diploidisation possible.

The development of a haploid hypha (*ab*) or (*AB*), which has just become diploidised owing to the entry into it of nuclei derived from either a haploid mycelium of opposite sex or from a diploid mycelium (*AB*) + (*ab*), is shown in Fig. 7, where it will be seen that, as the cells grow in length or branch, conjugate nuclear division takes place, and that each conjugate nuclear division is accompanied by the formation of a clamp-connexion. When, in a dung-ball, a diploid mycelium of *Coprinus lagopus*, like that shown in Fig. 7, stage 3, meets a haploid mycelium (*AB*) or (*ab*) of the same species (*cf.* Fig. 2) the diploid and the haploid mycelia doubtless fuse hyphally and the diploid mycelium diploidises the haploid mycelium (*cf.* Fig. 6), thus increasing the chances that one or more vigorous diploid fruit-bodies developing all the possible sexual kinds of spores (*AB*), (*ab*), (*Ab*), and (*aB*) will be produced rather than one or more relatively feeble haploid fruit-bodies developing only one of the four possible sexual kinds of spores. There can be no doubt that, in *Coprinus lagopus* and in other similar Hymenomycetes, the diploidisation of haploid mycelia by appropriate diploid mycelia is a distinct aid to reproduction.[4]

In conclusion, the author desires to acknowledge a grant in aid of the work made by the Research Council of Canada and valuable assistance in making the experiments given by Miss Ruth Macrae.

[1] W. F. Hanna, "The Problem of Sex in *Coprinus lagopus*", *Annals of Botany*, vol. 39, pp. 431-457; 1925.
[2] Dorothy Newton, "The Distribution of Spores of Diverse Sex on the Hymenium of *Coprinus lagopus*", *ibid.*, vol. 40, pp. 891-917; 1926.
[3] W. Lehfeldt, "Über die Entstehung des Paarmycels bei heterothallischen Basidiomyceten", *Hedwigia*, Bd. 64, pp. 30-51; 1922.
[4] A fuller discussion of conjugate nuclei has been prepared for vol. 4 of the author's "Researches on Fungi".

Recent Hydro-Electric Developments in Switzerland.

By Dr. BRYSSON CUNNINGHAM.

FROM the report for 1929 of the Swiss Service des Eaux, it is to be gathered that developments of hydro-electric energy have been prosecuted during recent years with unabated enterprise and zeal. There was merely a slight falling-off during 1929 in the productive capacity of the power stations, due essentially to the intense cold in the early part of the year and to depletion of the water supplies in the autumn. The returns show a total of 4178 million k.w.h. as compared with 4410 million k.w.h. and 4350 million k.w.h. in the two years immediately preceding. The adverse conditions necessitated recourse in a large measure to the supplies of water stored in the lakes, and the deficit was only made good towards the end of the year.

The most important installation put into operation during 1929 was the power station at Handeck, in connexion with the river Aar, an undertaking of the Forces Motrices de l'Oberhasli S.A., Innertkirchen. This has a present capacity of 60,000 horse power, with an ultimate possibility of 120,000 horse power. Among projects still in course of construction at the end of the year may be mentioned an installation on the Dixence in the Canton of Valais, of 175,000 horse power, and another of 50,000 horse power at Monte Piottino in the Canton of Ticino. An installation of 140,000 horse power at Ryburg-Schwörstadt on the Rhine will be partially Swiss.

It is computed that, on Jan. 1 last, the power stations in Switzerland, either in operation or in course of construction, aggregated a total capacity of about 2,700,000 horse power. Some of these stations are of considerable individual capacity, among them being those of Vernayaz (Canton Valais) for the Swiss Federal Railway, 108,000 horse power; Wäggital (Zurich), 90,000 horse power; Löntsch (Glarus), 66,000 horse power; and Laufenburg (Rhine), 65,000 horse power.

A recent visit to the Engadine brought me into close proximity with a number of hydro-electric installations which have materialised during the past quarter of a century. The district is particularly rich in sites affording scope for power development and some of these have now been exploited almost to the full extent of their capacity. One of the most striking examples, which I had an opportunity of inspecting, is the undertaking of the Brusio Power Company, which has its headquarters at Poschiavo in the extreme south of the Canton of the Grisons and within a short distance of the Swiss-Italian frontier.

The series of stages by which the Brusio Power Company develops the hydraulic capacity of the southern slopes of the Bernina Range and the Poschiavo Valley commences at the summit level of the Bernina Pass, where there are two sheets of water forming a natural reservoir for impounding purposes at a level of 2200 metres above the sea. The two sheets of water, more or less frozen, of course, during a considerable part of the year, are Lago Bianco (White Lake) and Lago della Scala (the precise signification of which between 'staircase', 'scale', 'succession', and 'landing-place' is not easy to determine). The former is much the larger of the two, but they are so closely adjacent within a common depression as essentially to form

a single basin, which has been adapted so as to provide a supply of 15 million cubic metres of water

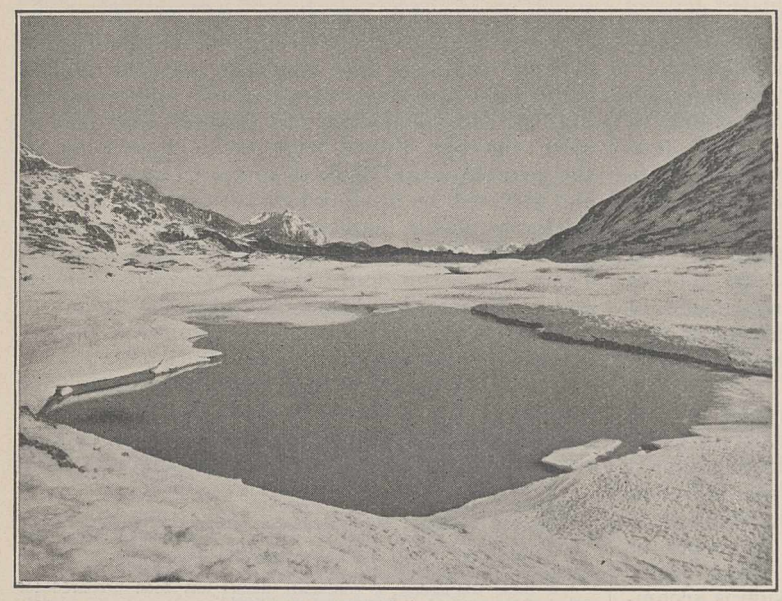

FIG. 1.—The Bernina Lakes reservoir at the summit level of the Bernina Pass. View looking south. By courtesy of Die Kraftwerke Brusio.

for power purposes. To this end, the two lakes have been connected and by means of dams at each extremity of the basin the water level has been raised 5·5 metres, bringing the surface up to 2236·16 metres above sea level over an area of 1·36 square kilometres. Under normal working conditions, the water level can be lowered to 2226 metres, which is the state of affairs shown in the photographic view of the basin reproduced as Fig. 1. In order to augment still further the available resources, a set of three pumps has been installed for drawing water from the deeper portion of Lake Bianco, by means of which the level may be reduced to 2210·16 metres above the sea, the maximum difference in level between the fully impounded and the most depleted condition being thus increased to 26 metres.

The Bernina Lakes reservoir is fed by an average annual precipitation of 1500 mm. in the catchment basin and by summer seasonal meltings from the Cambrena glacier.

From the snow and ice of the Bernina ridges two main valleys descend towards the south and eventually merge into one another in the Poschiavo plain. One of these, the Val Pila, receives the natural overflow from the two lakes described above and also the discharge from the Palü glacier at the foot of Piz Palü on the ledge overlooking Cavaglia, where it gives rise to the torrent Cavagliasco ; the other, the Val Lagoné, receives the flow of the upper Poschiavino, fed in turn by the streams from the Val di Campo. The Poschiavino, united with these tributaries at Robbia, passes through the valley of Poschiavo, having by this time attained an appreciable amplitude of flow, so far as Lake Poschiavo. This is an extensive natural basin lying at a level of 964 metres above the sea and having a superficies of 1·96 square kilometres. It is utilised to the extent of providing 14 million cubic metres of water for a power station below. For this purpose a retaining dam has been constructed across the bed of the Poschiavino at the point of exit from the lake and provided with an intake which is suitable for taking the discharge consequent upon lowering the lake level by 8½ metres. The lake is replenished in due course during the season of melting snow. After leaving the lake at Meschino, the Poschiavino descends 433 metres in a horizontal distance of 5 kilometres to the Swiss-Italian frontier at Campocologno. Beyond this station there is one further stage of development at the junction with the river Adda near Madonna di Tirano.

In all, the series of progressive developments consists of five power stations, situated in sequence at Palü, Cavaglia, Robbia, Campocologno, and Poschiavino. The

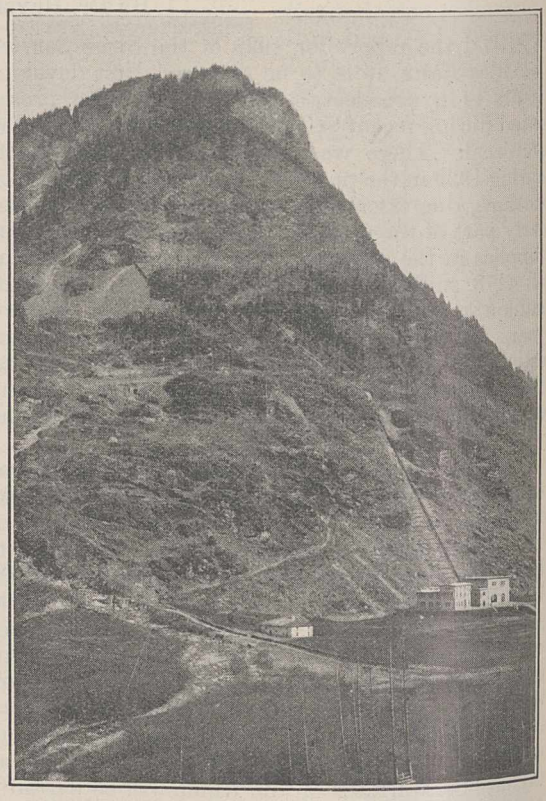

FIG. 2.—Power station at Robbia. By courtesy of Die Kraftwerke Brusio.

first of these, which receives its supply direct from the Bernina Lakes and the Palü glacier, has

a capacity of 15,200 horse power; Cavaglia power station, at a height of 1709 metres above sea level, develops 10,000 horse power; Robbia (Fig. 2), at a height of 1082 metres, develops 16,000 horse power; Campocologno (Fig. 3), at the level of 531 metres, develops 45,000 horse power, making a total within Swiss territory of 86,000 horse power, to which is to be added the 14,000 horse power of the Poschiavino station, bringing the total up to 100,000 horse power.

Nor is this the full tale of possible exploitation. The storage capacity of the Bernina Lakes and of that at the foot of the Palü glacier are susceptible of further artificial developments. The waters of the upper reaches of the Poschiavino in the Val Lagoné and of its influents from the Val di Campo are capable of being brought into use, as well as those of the Cavagliasco, the Bernina, and the Palü.

The record as it stands at present, however, is a most interesting example of the detailed, step-by-step utilisation of the full resources of an Alpine watercourse from its source in the glaciers of the summit to its final absorption in the comparatively low-lying and slow-moving river in the valley below—a descent which amounts to nearly 6000 feet. The conditions, of course, cannot be paralleled in Great Britain, but they are of interest as indicating how vast resources of power in mountainous regions, which for lack of knowledge and need of incitement have been ignored or neglected in the past, are now being brought into effective service. The works in question have been executed during the period of a quarter of a century commencing in 1903, the first installation at Campocologno having materialised in 1906, and the stations at Palü and Cavaglia having been put into operation at the close of 1927. A tribute is due to the initiative and foresight of the progenitors of the undertaking, as well as to the skill and enterprise with which the various sections of the work have been designed and carried out. I must also take the opportunity of expressing my acknowledgments to the Brusio Power Company, and in particular to the director, Herr Rickenbach, for the facilities which were courteously afforded me for inspecting the whole series of stations and for the information and photographs which have been kindly supplied at my request.

The electric current which is generated at the respective stations is transmitted between them by three principal lines of alternating current, three-phase, 23,000 volts, 55,000 volts, and 140,000 volts. The joint supply is transmitted northwards for utilisation in Switzerland by the Bernina Railway, the Rhaetian Railway, and by various local centres in the Engadine and even so far as Zurich; southwards, it is exported into Italy, where it is linked up with the system of the Lombardy Company serving the province of that name.

Had time permitted, it would have been interesting to inspect the series of power stations belonging to the A. G. Bündner Kraftwerke and located in the valley of Prättigau in the Lower Engadine. These have been in operation since 1922–23 and comprise installations of 14,000 horse power at Küblis, of 10,000 horse power at Klosters, and of 7500 horse power at Schlappin. Ultimately, the aggregate of the capacities is to be increased to 55,000 horse power.

Also, alongside the track of the Rhaetian Railway from Bevers to Chur, there is a power station at Thusis at the entrance to the Via Mala Gorge which utilises the water of the Hinter Rhine and develops energy to the extent of 13,500 horse power, which is supplied for the use of the railway system. The Albula station not far distant, of 26,600 horse power, should also be mentioned: it supplies current to the municipality of Zurich, as also does the Heidsee station of 13,000 horse power. Other sites are in course of exploitation.

FIG. 3.—Power station at Campocologno. By courtesy of Die Kraftwerke Brusio.

Sufficient, however, has been enumerated to show that, even on a quite casual and very cursory survey, there is impressive evidence of notable activity in the realisation to the fullest possible extent of the wonderful hydraulic resources of the numerous mountain chains which form the predominant and characteristic feature of the country. That this development has been and is of the greatest economic benefit to the Swiss community cannot be doubted for a moment. Natural hydraulic power is an asset of the highest importance, self-replenishing, and, unlike coal deposits, not subject to exhaustion.

Impressive and inspiring as is the solemn

grandeur of the crests and pinnacles of massive rock and ice which tower to the heavens in stately solitude, great mountain ranges have a further claim to distinction in an age of pressing utilitarian needs. The Alpine panorama with its multitudinous snowfields, glaciers, torrents, lakes, and rivers is no less wonderful as an example of how Nature contrives to compensate a country for its economic deficiencies in one respect by benefits of equivalent value, though of another kind.

Obituary.

Dr. Lewis Evans.

In the Lewis Evans Collection of Historic Scientific Instruments is a small jointed rule of ivory, inset with a compass needle, and engraved as a portable sundial. It was a special favourite of Dr. Lewis Evans, whose death occurred on Sept. 25 last, because it bears the inscription, "Registered 1853", which by a happy chance was the year of his birth, on Feb. 15. Twenty years later Francis Galton might well have included the Evans family among those English men of science whose hereditary influences and education he described at the Royal Institution, for at least four generations have achieved scientific distinction. The Rev. Lewis Evans, vicar of Froxfield, 1788–1827, was an accomplished mechanician and astronomer, who ground his own specula, recorded observations, and continued to 1864 the calculations on Ferguson's Astronomical Instrument and Rotula, published in 1817. He had been educated at Merton College, Oxford, was instructor in mathematics at the Royal Academy at Woolwich, and became a fellow of the Royal Society in 1823. He was in the habit of communicating mathematical notes to the *Reading Mercury* under the *nom de plume* of 'Felix Ford' (anagram of Froxfield), some of which are preserved with his lecture MSS. in the Lewis Evans collection. One of his sons, Thomas Simpson Evans, LL.D., became an assistant at Greenwich and, later, mathematical instructor at Woolwich. His grandson, Sir John Evans, K.C.B., for many years treasurer of the Royal Society, attained to special eminence as an antiquary, a branch of study which has been materially extended by both his sons—Arthur, who has also the scientific blue-ribbon of F.R.S., and Lewis, the subject of this notice, who died on Sept. 25. On the distaff side, two ancestors had also achieved similar distinction, namely, John Dickinson, F.R.S., F.S.A., and George Dionysius Ehret, F.R.S., the inimitable flower painter, who was born at Erfurt in 1708, and died at Chelsea in 1770.

Owing to the great demands made upon his time and energy by the needs of a great manufacturing business, Lewis Evans was more than forty years of age before he published his first paper, "On Pocket Sundials", a modest article illustrated by neatly executed cuts of the author's own drawing. This was followed by a fuller contribution upon the same subject to Mrs. Alfred Gatty's standard "Book of Sundials", 1900. His knowledge was largely based upon his own rapidly expanding collection of scientific instruments, in which a perfect Roman portable dial of about A.D. 300 was then one of the greatest treasures. In 1901 there appeared in *Archæologia* the account of another of his discoveries—the original dial of gilt brass made for Cardinal Wolsey by Nicholas Kratzer, who at the time was "reading Astronomy in the University by the command of King Henry VIII. and soon after made by Cardinal Wolsey his Mathematical Reader when he first settled his lecture there". Kratzer was made a fellow of Corpus by Richard Fox in A.D. 1517.

From this time on, many writers at home and abroad drew upon the experience of Dr. Evans, notably Dr. Joseph Drecker of Dorsten, and with the dispersal of other collections his own collection grew. It was many years before he could obtain an astrolabe, but "nothing succeeds like success", and the first he acquired was soon followed by some three score others, the most important of which he figured and described in "Some European and Oriental Astrolabes", in the *Archæological Journal* in 1911. In 1922 he offered the whole of his unique collection of dials and early scientific books and instruments to the University of Oxford. It is by far the most important collection of the kind that has ever been given to a university; and owing to peculiar circumstances, the present gift is a lasting memorial to the noble-minded generosity of the donor—for, like the Mensing collection, it might quite easily have been sold for a fortune to America, and thus have been lost to Europe. Incidentally it has served as a nucleus around which other benefactors, including many Oxford colleges, have deposited instruments and objects of value for illustrating the progress of scientific studies and research in the University. In the past five years the space needed for the proper exhibition of the collection has doubled in area, and apparatus of the very greatest importance has had to be refused, on the ground that the best exhibition space available in the Old Ashmolean Building is still being occupied by the staff and books of the English Dictionary, although that work was completed many months ago.

As was recently pointed out in NATURE in a letter signed by the president of the Institute of Physics and others, scientific instruments, often the landmarks of invention, are lost so long as they are hidden and not in the charge of someone who appreciates their scientific value. No one realised this more vividly than did Dr. Lewis Evans himself. Although an ardent admirer of art and craftsmanship, he felt that to place unique instruments of science among art objects in a gallery of art, as is the case in the British Museum and at South Kensington in London, or at the Ashmolean Museum in Oxford, or to group scientific apparatus among books and to catalogue it as 'manuscripts', as is now the practice in the Bodleian Library, is both derogatory to science and destructive to the proper study of its history. He therefore determined that

his collection should either 'go to the hammer', or else be shown as a scientific collection with all the advantages of exhibition that art collections usually enjoy. By the greatest good fortune, a part of the most historic building connected with the early history of science in Britain, the Old Ashmolean, was available, and this being approved by Dr. Evans, was allocated by the University to his collection. The Goldsmiths' Company voted £1000 for initial expenses, and is now offering £500 more if and when a greatly needed extension of exhibition space is forthcoming either in the Old Chemical Laboratory or in the original meeting-room of the Oxford Scientific Society of 1683. A benefactor to complete the good work which Dr. Lewis Evans has so generously begun is urgently needed, for the losses of most important instruments are great and are continuing. R. T. G.

THE RIGHT HON. EDWARD ALLEN, BARON BROTHERTON OF WAKEFIELD.

THE career of a great industrial leader is not one which demands from him a platform exposition of his aims, policy, and programme as a condition of success, but perhaps all the more on that account any self-revealing utterances from such a man have a peculiar interest and special value. With Lord Brotherton, who died on Oct. 21 at the age of seventy-four years, it so happened that, in the last few months of his long and strenuous life, circumstances combined to break the barriers of constitutional reserve and led him to speak to sympathetic listeners of his experiences and aspirations.

Three occasions, different in character, come to the mind of the present writer. The first of these was the laying of the foundation-stone of the Brotherton Library at the University of Leeds. Lord Brotherton there spoke in firm voice and measured sentences of carefully prepared wording to an audience of the University and its friends. It was a dignified expression of what was in his mind in making this generous monetary gift, which should enable the University to erect a noble building for the housing of its library, and in adding thereto not only the fine collection of books which it had been his pride to bring together in his own home, but also an endowment to secure their care and maintain their usefulness.

On the same evening Lord Brotherton was the guest of the University at a dinner, and there, speaking with feeling and in simple, direct, and unprepared language, it was evident that he had the greatest possible wish to escape from his habitual reserve, and to get into closer human contact with the members of the Senate and others whose academic life and outlook were necessarily so different in some respects from his own. The sincerity and unconventionality of this speech were remarkably impressive.

On the third occasion, a little later, Lord Brotherton was in the midst of his fellow-members of the Society of Chemical Industry, who had marked their appreciation of his high standing and achievements as a master of their calling by conferring upon him the Messel medal and inviting him to deliver the Messel lecture at the annual meeting of the Society in Birmingham. He expressed at once his intention of dealing with what he knew best, and told the story of his own connexion with industrial chemistry. He told how he left Owens College to engage, in the first place, in the manufacture of ammonium sulphate, and showed how he was able to extend his operations in various directions, mainly by organisation, insight into the opportunities presented by the introduction of new chemical processes, and the determination to place his resources boldly at the back of any venture which had won his confidence. So came into being and good fortune the firm which bore his name, and so later arose his connexion with the Cassel Cyanide Company, of which he became chairman in succession to Sir George Beilby.

These three occasions of self-explanation came close in time to the termination of a career marked in equal measure by outstanding achievement and the exercise of a large-minded generosity.

J. W. COBB.

DR. E. H. WILSON.

THE death of Dr. Ernest Henry Wilson on Oct. 15, as the result of a motoring accident, will be lamented in botanical and horticultural circles, not only in Britain and America, but also throughout the world, for Wilson's activities were truly international. The news to hand from the Arnold Arboretum states that Mr. and Mrs. Wilson were returning from a visit to their daughter and her husband, Mr. and Mrs. G. L. Slate, at Geneva, New York State, when their car skidded on the greasy surface while travelling on the Boston Road, Worcester, Mass., crashing through a fence and down a 40-feet embankment. Mrs. Wilson was killed outright, and Dr. Wilson died soon after admission to hospital.

Wilson was born at Chipping Campden, Gloucestershire, on Feb. 15, 1876. He entered the Birmingham Botanic Gardens as a student in 1892 and moved to Kew in January 1897. In the lecture room and in the practical work of the Gardens it is evident that Wilson soon attracted attention, as he obtained first place in several of the lecture courses, and was awarded the Hooker Prize of the Mutual Improvement Society for an essay on Coniferæ. Wilson's next move was to the Royal College of Science, South Kensington, where he obtained a studentship with a view to becoming a teacher in botany.

At this time, the late Dr. Augustine Henry was sending home specimens—a few seeds, and letters descriptive of the floral wealth of Hupeh, China. Messrs. Veitch, of Chelsea, decided to send out a collector, and asked the then Director of Kew, Sir William Thiselton-Dyer, to recommend a suit-

able man. Wilson was chosen, and made his first journey between 1899 and 1902. This proved so successful that a second journey was made during 1903–5. Two further trips followed in 1907–9 and 1910–11, these journeys being on behalf of Harvard University and a few subscribers. The results of his labours are recorded in "Plantæ Wilsonianæ", which contains descriptions of 3356 species and varieties. Of these, nearly nine hundred were new, including several new genera. In 1914 and 1917 Wilson made two journeys to Japan. He was appointed Assistant-Director of the Arnold Arboretum in 1919. The next year he set out on a two years' tour through Australia, New Zealand, India, and Central and South Africa. On the death of Prof. C. S. Sargent in 1927, Wilson was appointed Keeper of the Arnold Arboretum.

An untiring worker, Dr. Wilson found time to write nearly a dozen books on his plant collections and studies. The best known of these are: "A Naturalist in Western China", 1913; "Cherries of Japan", 1916; "Conifers and Taxads of Japan", 1916; "Lilies of Eastern Asia", 1925; and "Aristocrats of the Garden", 1926. His work received recognition from numerous learned societies, including the Victoria medal of the Royal Horticultural Society in 1912, the Geoffrey St. Hilaire gold medal, the George Robert White medal, the Veitch memorial medal, and the Rhododendron Society's cup. He was a fellow of the American Academy of Arts and Sciences, an honorary M.A. of Harvard University, and in June last Trinity College, Hartford, Conn., conferred on him the degree of D.Sc.

As a plant collector, botanist, horticulturist, and author, Dr. Wilson possessed great knowledge of his subjects. He was also himself a very likeable man, which makes his loss the greater. A. O.

Prof. Florian Cajori.

We much regret to record the death, which occurred on Aug. 14, of Prof. Florian Cajori, professor of the history of mathematics in the University of California. An appreciation of his work by Prof. David Eugene Smith appears in *Science* of Sept. 19, to which we are indebted for the following particulars. Florian Cajori was born in Switzerland on Feb. 28, 1859, and went to the United States when he was sixteen years of age. Between 1889 and 1918 he was at Colorado College, first as professor of physics, later as professor of mathematics, and finally as dean of the Department of Engineering. Throughout this period he paid particular attention to the history of his subjects. In 1918 he went to the University of California as professor of the history of mathematics. Cajori was the author of several works on the history of the physical sciences and mathematics, and at the time of his death was engaged on an edition of Newton's "Principia". His most important work was "The History of Mathematical Notations" (2 vols., 1928, 1929); while his "History of the Logarithmic Slide Rule" (1909) is still one of the most authoritative treatises on the subject.

We regret to announce the following deaths:

M. Paul Appell, president in 1914 of the Paris Academy of Sciences, and more recently Rector of the University of Paris, who was distinguished for his mathematical work, on Oct. 23, aged seventy-five years.

Dr. W. R. Eckardt, director of the Meteorological Observatory at Essen, and author of "Grundzüge einer Physioklimatologie der Festländer", aged fifty-one years.

Dr. W. M. W. Haffkine, C.I.E., formerly bacteriologist with the Government of India, distinguished for his research work on plague and cholera, on Oct. 26, aged seventy years.

News and Views.

No one more appropriate than Mr. H. G. Wells could have been found to introduce Prof. L. T. Hogben to his audience on Thursday, Oct. 23, when he read himself in as professor of social biology at the London School of Economics. Mr. Wells hailed the new experiment in bringing biology and economics together as the portent of a complete change of direction and method for the social and economic sciences, and spoke of it as a most exciting event. He did not spare the traditional treatment of the dismal science, which, dealing with human things, was, he said, entirely inhuman. While pretending to be a science, it began with hypotheses and definitions in the mediæval manner, and maintained to the present time the flavour of scholasticism. It would not have been Mr. Wells if he had not clearly been rejoicing in the belief that the new chair would be revolutionary: with the rapid advances in the knowledge of the biology of man made in the last quarter of a century, the new body of knowledge which can be brought to bear on sociology and economics will bring them within the region of pure scientific treatment. He defined the scope of Prof. Hogben's work as the treatment of one special case of the science of ecology, the science of the balance and welfare of species—the study of the fluctuations of the human species under the fluctuating pressure of circumstances. Mr. Wells paid the London School of Economics the compliment of finding the establishment of research into this new byway of science only what one would expect of it, and he described the new professor as a most hopeful and desirable adventurer.

Prof. Hogben's address, a synopsis of which appears elsewhere in this issue, did nothing to damp the liveliness of Mr. Wells's hopes and anticipations. It was a brilliant example of the exposition of a difficult scientific thesis in terms of smooth prose enriched by a wealth of humour and literary allusion. Prof. Hogben is not overwhelmed by the scope or the difficulty of the adventure on which he has embarked. Although Mr. Wells suggested that he was about to cut the first furrow in an almost virgin soil, it is plain enough that the territory has already been surveyed, and that it will not be a random

direction that this furrow will take. Nevertheless, Prof. Hogben sounded warning notes. He pointed out that the outlook which evolutionary biology brings to the study of human society is neither a philosophy of social reform nor a philosophy of social reaction but a philosophy of social discovery. Above all, he drove home the need for discipline, restraint, and detachment in the discussion of the genetical foundations of racial and occupational stratifications in human society. To force the issues into the political arena at the present stage of inquiry would be to render these virtues impossible to exercise. In conclusion, Prof. Hogben, changing the metaphor, begged that an astronomical estimate should be taken of the time required for the seed now being sown to germinate. Accepting the conclusions of Sir James Jeans, the School of Economics has five million million years of life in which to cherish and tend it. Prof. Hogben indicated that he confidently relied upon the School, with its tradition of free inquiry, to extend the necessary care and sympathy in its early, tender stages.

SIR DAVID PRAIN'S Alexander Pedler Lecture, delivered in the University of Liverpool on Oct. 22, under the auspices of the British Science Guild and the University, explored the troublesome problem of the academic attitude towards applied science. The term science discipline, which was Huxley's description of the methods of obtaining natural knowledge contrasted with technical exercise in the employment of natural knowledge, opened the door for a review of Huxley's ideas concerning the place of science in the universities, side by side with an historical account of the changing mutual relationships of the arts and the sciences since the fourteenth century. Sir David Prain had no difficulty in showing that in Huxley's mind the purpose of science discipline was twofold: to furnish those who wished to serve the community scientifically with the kind of natural knowledge that would prepare them for technical training, as well as to render all scholars in any ideal university competent to appreciate the scientific help afforded the community by those specially trained to give it. To orientate the first of these purposes falsely, while wholly ignoring the second, is to accentuate the antithesis held to exist between 'pure' and 'applied' science, and leads to the neglect by those entrusted with university organisation of the 'patient study' of the special features of science discipline for culture and science discipline for training that Huxley clearly envisaged. The idea that an advance in natural knowledge, however slight, is of greater consequence than any application of natural knowledge, however important, arises from an unreal distinction between 'pure' and 'applied' science. Teachers of natural history in the eighteenth century used system, and teachers of philosophy in the sixteenth century used controversy, as ends in themselves, with well-known consequences. Twentieth century teachers of science, said Sir David Prain, have to guard themselves against a like misuse of discovery.

HUXLEY'S views concerning the place of science in universities were comprehensive. Science implanted in the misnamed 'Arts' faculty was to lead men to an understanding of all the methods of obtaining knowledge. Acquisition was incidental, but inevitable and extensive. The science faculties were to be intensive, supplementary to arts, and preparatory to training, but nevertheless cultural as a matter of necessity. It is a curious reflection on the antagonisms that praise of the useful engenders that art (in the unequivocal singular) has survived similar trials. Surely no artist now ever worries his head about 'art for art's sake', not because he has comprehended this once provocative assertion or disposed of it, but because it has ceased to stand for anything real. A quarter of a century later, science for science's sake still has power to wound. Science for the sake of its supreme intellectual interest is not something that leads to the contrasting of "second-rate advancement with first-rate application". Active and powerful minds are not usually undiscriminating. They imply, as a rule, powerful motives. Science for the sake of its impressive material consequences is none the less science. Another reflection concerning the place rather than the matter of Sir David Prain's stimulating address, is that the University of Liverpool is now the only 'scientific body' in Liverpool that could invite an Alexander Pedler lecturer in accordance with the conditions of the foundation. The courtesy of the University is warmly appreciated by those concerned in arranging the lecture; but it may be remarked, for the encouragement of creative culture in Liverpool, that the learned societies that still flourish in some Scottish and provincial centres have not only a great and honourable past but also a respectable present and a worthy future. Reference books give the Royal Institution of Liverpool a theatre, a library, a lecture-room, a museum, a room for the use of scientific instruments, and even a laboratory. The functions that these amenities suggest should be restored to it.

THE centenary celebrations of the Royal Geographical Society began on Oct. 21, when the Duke of York, representing the King, who is the Society's patron, formally opened the new lecture theatre and the library and other buildings which have been added to the Society's house at Lowther Lodge, Kensington Gore. In declaring the building open, the Duke of York mentioned that the Society is the third of the great geographical societies of the world to celebrate its centenary, having been preceded only by the Société de Géographie de Paris in 1921 and the Gesellschaft für Erdkunde of Berlin in 1928. The new lecture hall has seating accommodation for at least 860 and its acoustics are admirable. A wide ambulatory connects the old building with the new, and its circuit gives ample space for movement and conversation after evening meetings. The library and map collections now have considerably increased space. Addresses of congratulation were presented by delegates representing many geographical societies throughout the world and kindred societies in Great Britain. Several of the visiting delegates were made honorary members of the Society.

ON the evening of the opening day of the celebrations, addresses on the history of the Royal Geograph-

ical Society were delivered by Sir Charles Close (president), Dr. H. R. Mill, Mr. D. Freshfield, Sir Francis Younghusband, and the Marquess of Zetland. On the following day there began a series of papers on the habitable globe. Dr. A. Penck refuted the theory that within historic times there has been any considerable or progressive change of climate in Central Asia, and Prof. J. W. Gregory outlined the evidence against any change of climate in Palestine within the same period. Mr. L. B. S. Leakey, in speaking of East Africa, stated that the suitability of conditions in that country for permanent white settlement have yet to be proved, but he believes that they are probably favourable. This series of papers was continued on the next day by Prof. A. M. Carr-Saunders and others, and several short papers on striking episodes in recent explorations were given by various travellers. Other events in the celebrations included a reception of delegates and fellows in the Society's house on Oct. 22 and a centenary dinner on Oct. 23, at which the Prince of Wales presided.

THE centenary of the birth of John Whitaker Hulke, eminent as a surgeon and a geologist, occurs on Nov. 6. In his day he was president of the Geological Society of London (1882–84) and president of the Royal College of Surgeons (1893–95) an unusual association of scientific activities. Born at Deal, the son of a medical practitioner in the town, he was educated in Germany and at King's College School. He rendered medical service in the Crimean War, becoming afterwards surgeon to Middlesex Hospital, where, apart from geology, most of his life's work was accomplished. In 1859 his well-known essay, "Diseases of the Retina", was awarded the Jacksonian prize of his college. It was followed by a treatise on the ophthalmoscope, an instrument in use in Germany but at the time unfamiliar amongst English practitioners. He edited (with J. Burdon Sanderson) the collected papers of Sir William Bowman. Hulke was elected into the fellowship of the Royal Society in 1867, his claim being based exclusively on researches relating to the anatomy and physiology of the retina in man and the lower animals, particularly the reptiles. His knowledge of comparative anatomy, and especially of osteology, enabled him rapidly to grasp the meaning of structures presented by the remains of fossil vertebrates. It is said that he found relaxation from professional anxieties by working with his own facile chisel on the freeing of fossils from their matrices. Hulke was a faithful servant of the Geological Society, occupying not only the presidential chair, but also filling the posts of secretary and foreign secretary. He died in London, on Feb. 19, 1895.

THE Freshwater Biological Association, the principal object of which is to secure the establishment of a freshwater research station to investigate the numerous outstanding problems of freshwater biology, has secured the support of the leading scientific societies and of a large proportion of the bodies interested in water pollution, freshwater fisheries, and the like. The conference convened by the Council of the Association at Fishmongers' Hall on Feb. 21 last (see NATURE, Feb. 15, p. 241) afforded striking evidence of the interest displayed, and showed that there was a real and widely felt need for such a station. Promises of financial support in the form of annual grants have been received from many sources, but they are conditional upon the actual founding of the station as a research centre. The Council is therefore making an appeal for contributions towards a fund for the establishment and initial equipment of the station, and several hundred pounds have already been subscribed. To make a satisfactory beginning a sum of between three and four thousand pounds is, however, required. The Council is appealing especially to those interested in freshwater, such as public bodies responsible for water supply, medical officers of health, water and sanitary engineers, fishermen, and naturalists, who should realise the importance of the projected station in relation to the conservation and development of freshwaters and their amenities on an economic and scientific basis. Contributions should be sent to the treasurer of the Association, Mr. D. J. Scourfield, 6 Chadwick Road, Leytonstone. The chairman of the Council of the Association is Prof. F. E. Fritsch, and Mr. F. Balfour-Browne, Winscombe Court, Winscombe, Somerset, is acting secretary.

IN an address to the Liverpool Centre of the Institution of Electrical Engineers, delivered on Oct. 20, Mr. A. J. Pratt gave interesting statistics illustrating the very rapid growth of telephony. The first actual talking instrument was constructed in 1875, and on Mar. 7, 1876, the famous Bell patent was issued. In 1929 the Bell System of the American Telephone and Telegraph Co. controlled ninety million lines, with a total of about sixty-five million calls a day. If we count companies in the United States, we find that the Bell Telephone Co. is only one in ten thousand. Some of these companies, however, are very small. A universal linkage of all the telephones in the world by the aid of radio transmission is in process of realisation. It is impossible to separate the local exchange from the long-distance telephone system, as each is mutually dependent on the other. In Great Britain an immense programme of building and exchange plant reconstruction has been worked out since the War. There are now nearly 5000 exchanges, more than 300 of which are automatic. When the business man, following the American custom, needs a telephone not only in his office but also in his sitting-room and bedroom, the present rate of growth of telephony will rival that of radio broadcasting in Britain, which in the short space of seven years has attracted more than three million licensed listeners. Post Office officials consider it very desirable that the telephone habit be cultivated. It is suggested that this can be done by a wider application of the use of the internal extension telephone.

THE presidential address delivered at Newcastle on Oct. 24 by Mr. J. McGovern to the North-East Coast Institution of Engineers and Shipbuilders was devoted to a brief review of modern shipbuilding. Referring to the position of the north-east coast of Britain in the shipbuilding and engineering industry, Mr. McGovern

said that in 1929, 750,000 tons of ships were launched in the district, while the machinery completed had an aggregate of 682,000 horse power. Great Britain is now building 45 per cent of the world's tonnage, as compared with 57 per cent in pre-War years. Recent progress in naval architecture is one of steady research rather that of epoch-making development; but it cannot yet be claimed that experimental technique has reached a stage where we can be wholly satisfied with the results obtainable. The correlation of model tests with actual service results is rendered difficult by the insufficient precision with which powers obtained at sea can be measured. The chief uncertainties arising from attempts to correlate model and ship appear to lie in the assessment of a frictional value for the ship's hull surface, the effect of ship propeller roughness, the probability of some 'scale' effect in extending model results to the ship's actual size, and the comparison between screw performances in the open and in the varying flow obtaining at the stern of varying forms of vessels. Discussing the question of oil engines and steam engines, Mr. McGovern said that the investigations now proceeding may result in giving a new lease of life to steam as a prime mover. There would appear to be considerable economies obtainable by the use of high-pressure superheated steam plants, while the results already achieved in the ships of the Canadian Pacific Steamship Company are unequalled by other prime movers. In other directions, research is also being applied to the determination of strains and the subject of vibration in ships.

SIR ROBERT ROBERTSON, the Government Chemist, reporting on the work of the Government Laboratory for the year ending Mar. 31, 1930, gives a detailed survey of the many activities, interests, and responsibilities of his department. A comparison with last year's report shows that there has been a substantial increase in the number of samples examined, now well above the half-million mark, the rate of increase also having risen considerably. The chemical staff has increased from eighty to eighty-two; the long list of 'other activities' of the members of the staff again demonstrates the important part taken by the Laboratory in the promotion and application of chemical science. References to the absence of any standard for the percentage of fat in cream and to the absence of regulations relating to the marking of skimmed or partially skimmed milk cheese are repeated, and the presence of 2-5 per cent of proof spirit in samples of 'non-alcoholic' beverages is again reported. The number of samples of sea water examined for the Admiralty, the Ministry of Agriculture and Fisheries, and the Fishery Board for Scotland shows a substantial increase; this work is, of course, of noteworthy value in oceanography, since systematic determinations of salinity contribute to our knowledge concerning the drift of water between seas of differing saline contents. Further study has also been made of the diurnal variation in the quantity of dissolved oxygen in rivers; this variation is traceable in some rivers throughout the year. Atmospheric pollution also has been a subject of experimental investigation; a standard apparatus and method for determining the acidity of the air are now being tested at several stations. It appears that free sulphuric acid is present in a proportion which does not exceed a small fraction of the total sulphurous acidity, and that neutral sulphates are also present in small quantities.

UNDER the Food and Drugs (Adulteration) Act, 1928, the Government Laboratory was called upon to report to the Justices on nineteen samples, with the result that in four cases the results were in disagreement with those put forward by the prosecution. All four cases were concerned with milk or butter. Two samples of tinned vegetables examined for the Ministry of Health contained copper, whilst four contained hydrogen peroxide. Six samples of lead pipe carrying a municipal water supply were found to contain deposits of two kinds, one consisting mainly of basic lead sulphate and the other of basic lead carbonate. Deficiencies in condensed milk were found, but most of the adverse reports were concerned with the labelling. All consignments of tea which are imported into Great Britain are subjected to examination, officers of Customs and Excise being trained, for the purpose of preliminary examination, in the Laboratory. Of about thirty thousand samples, 256 contained foreign substances and 217 were unfit for human consumption. Of 1546 samples of beer, 32 contained arsenic in slight excess of the limit laid down by the Royal Commission on Arsenical Poisoning, but in no case (of 85 examined) was saccharin detected. A sample of soap alleged to be made wholly from waste potatoes consisted of ordinary soap loaded with sodium carbonate and starch; whilst two samples of meat meal were adulterated with potato and with mineral matter respectively. As the result of further examination of lime-sulphur insecticides, it has been possible to work out the relationships between the various suggested criteria of strength of these products. During the year more than 200 milligrams of high-grade radium salt have been recovered from decayed luminous paint.

THE sphere of work of the League of Nations' Committee on Intellectual Co-operation has recently formed the subject of a general inquiry by a committee specially constituted for the purpose at Geneva. In the light of this committee's report, a number of proposals have been submitted to and approved by the Assembly of the League with the object of defining a programme and improving work in this field. Among the changes thus brought about is the constitution of committees of experts which will replace the formerly existing sub-committees of the League's International Committee on Intellectual Co-operation. An inquiry is to be initiated forthwith into the intellectual life of our time with special reference to methods of education at all stages in the different countries. The attention of governments is being directed to the utility of the work done by the bureaux responsible in the different countries for international interchanges of publications, with the suggestion that they should "be placed in a position to act as liaison between learned societies for exchanges of their publications and should

accordingly be provided with the necessary funds". The work of the International Educational Cinematographic Institute, including the publication in five languages of the *International Review of Educational Cinematography*, is highly appreciated by the Assembly of the League; and governments are being asked to give their sympathetic consideration to the draft convention, prepared and circulated by the Institute, for the abolition of customs barriers which interfere with the distribution of educational films, and generally to lend their aid and support to the Institute.

MANY generous donors have contributed to make the collection of birds in the Hull Municipal Museum fairly representative of the avifauna of the British Isles. The addition of many specimens and the rearranging of the birds of prey, the waders, and the game birds have made necessary the publication of a new "Guide to the Birds" by Mr. T. Sheppard. In it the collection is catalogued, with records of localities, a short comment on the status of each species, and two dozen illustrations of typical examples of the style of mounting adopted. Perhaps it is desirable from the public point of view to keep the nomenclature as simple as possible, and doubtless on this account no racial forms are indicated. But for the study of bird migration or for scientific identification, more than the Linnean binomial is required—and, indeed, the simple method may be misleading. For example, it is obvious that the specimens of golden plover (case 209), described as generally distributed throughout the British Islands, do not belong to the British race at all. The Guide contains many interesting Yorkshire records, and it is unfortunate that the cases should sometimes contain incongruous species (crested tit and abnormal skylark) and sometimes associate British with foreign species which have no British claims (red grouse and willow grouse).

AMONG the recent acquisitions of the British Museum (Natural History) are the following: The Trustees of the Rowland Ward Bequest have presented a fine mounted female specimen of a black howling monkey (*Alouatta niger*). The female is not, as the name of the species implies, black in colour, but a mixture of grey and yellow. A plaster cast of the bust of a young gorilla (John Daniel I.) and a cast of the entire left foot and ankle have been presented by Mr. F. O. Barlow and will shortly be placed on exhibition in the Upper Mammal Gallery. The Government of Greenland recently presented to the Museum a Greenland narwhal. The specimen, which is a male, 10 feet 3 inches in length, with a tusk 14½ inches long, was sent from Greenland packed in salt and arrived at the Museum in excellent condition. A plaster cast of the animal has been prepared and will be exhibited when the new Whale Room, now under construction, has been completed. Among the recent acquisitions in the Department of Geology are three interesting fossils—a fish and two palms—from the Middle Eocene beds of Bolca, near Verona. The fish is a fine example of a rare extinct genus, *Urosphen*, related to the living flute-mouths. The palms, which are both on slabs about six feet in length, are almost complete specimens of small fan-palms. The Department of Botany has received a collection of 101 seaweeds from Sir J. Ross's voyage of the *Erebus* and *Terror* to the Antarctic (1839–43), presented by Miss Jessie Lefroy. The Department already has the flowering plants of the expedition, to which Dr. (afterwards Sir) J. D. Hooker was naturalist. Many cryptogams were received from 1845 to 1854, and a further set was bequeathed, together with his Arctic collection, by Dr. R. M'Cormick, surgeon to the expedition, in 1890. The collection now added is valuable in extending the series and has an additional interest in that it was originally presented to Lady Franklin.

SIR ROBERT HADFIELD recently delivered an address, on the occasion of a luncheon of the Oil Industries Club, in which, after giving a general survey of the importance of the steel industry, that of gold being taken as a standard of comparison, he discussed the question of steels for use in the oil industry. For the purpose of rock drills no alloy steel has proved to be superior to plain carbon steel in cutting quality. The carbon is usually in the neighbourhood of 0·75 per cent, but when special care is taken to keep down the proportions of sulphur and phosphorus, the carbon may be raised to 0·85 per cent. Carbon steels are, however, deficient in toughness, so that small quantities of an alloying element, such as 0·2 per cent of vanadium or 0·6 per cent of chromium, may be added with advantage. Great care in heat treatment is essential, as surface imperfections give rise to fatigue cracks. For the fish-tail bits used in rotary drilling, and for core barrel cutter heads, excellent results have been obtained with an intermediate manganese steel, comparatively low in carbon, but containing 1·5-1·75 per cent of manganese. Such steel, when quenched, has a Brinell hardness of 550-575, and exhibits great toughness. The oil industry has also made demands on the steel-maker for heat-resisting steels in connexion with operations at high temperatures.

AN illustrated description of the construction of the large reinforced concrete tube for vehicular traffic which has been laid in the bottom of the estuary which separates the cities of Oakland and Alameda, on the shores of the Bay of San Francisco, is given in *Engineering* for Sept. 26 and Oct. 10. Owing to the geological formation, the driving of a tunnel beneath the estuary was impracticable and the unusual plan had been adopted of building a great part of the tube in lengths in a dry-dock and then sinking them into position after they had been floated. The total length of the structure is 4336 ft., and this includes 12 tubular sections each 203 ft. long, which were built in the dock. These sections have an external diameter of 37 ft. and are 2 ft. 6 in. thick, the concrete being heavily reinforced both circumferentially and longitudinally. Internally, the tube is divided into three sections by a ceiling and a roadway, the space above the ceiling being used as an exhaust duct and that under the roadway as a fresh-air duct. As completed each section weighed about 5000 tons, and as some of the sections were slightly curved, great care had to be

taken with their alignment. All the sections were, however, successfully sunk into position and then neighbouring sections were joined together by circumferential belts of Tremie concrete. The entrance portals are of a striking character and in them are housed the ventilation plants. The tube has a capacity of 4224 vehicles per hour when they are proceeding at 20 miles per hour; while the ventilation is such that it allows for but 4 parts of carbon monoxide in 10,000 parts of air. This remarkable engineering structure is called the Geo. A. Posey tube, after its designer.

THE second Henry Herbert Wills Memorial Lecture in physics was delivered in the H. H. Wills Physical Laboratory, Bristol, on Saturday, Oct. 25, by Prof. J. Franck, of Göttingen. The title of the lecture was "The Relation between Spectroscopy and Chemistry". Prof. Franck outlined a number of methods of determining the heats of dissociation of molecules from their molecular spectra, and showed how it is possible by spectroscopic methods to classify various types of chemical binding. He also indicated methods of deducing another thermochemical constant, namely, the heat of activation, and gave a qualitative physical picture of the function of a catalyst in promoting homogeneous chemical reactions. The lecture was well attended, and the audience included a number of visitors from other universities.

THE second of a series of exhibitions, at the galleries of the Royal Photographic Society, to illustrate the application of photography to the various branches of science, art, and industry, is to be devoted to "Photography in Astronomy". The striking results which have been secured by the combination of the photographic plate and the spectroscope will be well exemplified, and photographs of star fields, nebulæ, and other objects, many of which have been revealed by photography, will be on view. There will also be illustrations of instruments, telescopes, cameras, used in the different branches of astronomical research. The exhibition will be open daily at the Society's house, 35 Russell Square, London, W.C.1, on Nov. 3–29 (Sundays excepted), from 10 A.M. to 5 P.M. There will be no charge for admission. Lectures will be given during the exhibition—by Prof. F. J. M. Stratton, on Nov. 3, on "Solar Eclipse Photography"; by Prof. Herbert Dingle, on Nov. 17, on "Spectrum Photography"; and by Mr. J. H. Reynolds, on Nov. 24, on the slides and films in the exhibition.

DR. HENRY FAIRFIELD OSBORN, president of the American Museum of Natural History, has been awarded the Daniel Giraud Elliot Medal for 1929 by the U.S. National Academy of Sciences for his recent monograph on Titanotheres.

THE sixth annual Norman Lockyer Lecture of the British Science Guild will be given by Sir William Pope in the Goldsmiths' Hall, Foster Lane, E.C. (by permission of the Goldsmiths' Company), on Thursday Nov. 13, at 4.30 P.M. The subject of the lecture will be "Science and Modern Industry". Sir Samuel Hoare, president of the Guild, will take the chair. There will be no charge for admission to the lecture, tickets for which can be obtained from the British Science Guild, 6 John Street, Adelphi, London, W.C.2.

HIS GRACE THE ARCHBISHOP OF YORK will deliver an address on "The Relations between Philosophy and Religion", at University College, Gower Street, W.C.1, on Tuesday, Nov. 18, at 8.15 P.M. The chair will be taken by Sir Oliver Lodge. Tickets for this meeting, which is one of a series arranged by the British Institute of Philosophical Studies, can be obtained, without charge, from the Director of Studies, University Hall, 14 Gordon Square, London, W.C.1.

AT the annual statutory meeting of the Royal Society of Edinburgh, held on Oct. 27, the following Council was elected: *President*, Sir E. A. Sharpey-Schafer; *Vice-Presidents*, Prof. J. Graham Kerr, Prof. W. Wright Smith, Prof. F. G. Baily, Prof. T. J. Jehu, Prof. J. H. Ashworth, Dr. A. Logan Turner; *General Secretary*, Prof. R. A. Sampson; *Secretaries to Ordinary Meetings*, Prof. C. G. Darwin and Prof. James Ritchie; *Treasurer*, Dr. James Watt; *Curator of Library and Museum*, Prof. D'Arcy W. Thompson; *Councillors*, Dr. J. B. Clark, Prof. F. A. E. Crew, Prof. J. Montagu F. Drummond, Mr. D. A. Stevenson, Prof. H. W. Turnbull, Sir James Walker, Dr. James Drever, Mr. A. H. R. Goldie, Dr. R. A. Houstoun, the Hon. Lord Sands, Mr. Murray Macgregor, and Dr. A. Crichton Mitchell.

AT the Imperial Botanical Conference held on Aug. 15 at the Imperial College of Science and Technology, South Kensington, the following resolution was carried unanimously: "That an Imperial Botanical Conference take place in England in 1935, shortly before the International Botanical Congress which is to be held in that year in Holland." The following interim committee was appointed: The Director of Kew (convener); the Keeper of Botany, Natural History Museum; the professors of botany at Oxford and Cambridge; a professor of botany of the University of London (to be nominated by the chairman of the Board of Studies of the University); one representative of the Colonial Office, and one representative of the Dominion Office. It was further resolved that this Committee summon a meeting of British botanists in the near future for the purpose of appointing an executive committee for the said Conference.

THE first number of a new journal called the *Students' Quarterly Journal* has been published by the Institution of Electrical Engineers. Its object is to record the work done by the students' sections of this Institution and to publish short papers by them dealing with technical subjects of general interest. This number is notable, as it gives an abstract of a most interesting lecture on the ship-to-shore radiophone service by Sir Thomas Purves, Engineer-in-Chief to the Post Office.

WE have received Vol. 8 (1929) of the *Transactions* of the Institution of Chemical Engineers, which contains several papers of considerable interest. These

deal with the reactivity of coke, fatigue in metals, acid-resisting steel plant (in which precise directions for oxy-acetylene welding are given), the recovery of benzole from coal gas by adsorption, the absorption of nitrous gases, the fractional adsorption of gases, the industrial applications of active carbon, the evaporation of water in open pans, etc. The volume is fully illustrated and contains numerous tables, and is a production of very high standard.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—An assistant director of the Research Laboratory of Queen Charlotte's Maternity Hospital—The Secretary, Queen Charlotte's Maternity Hospital, Marylebone Road, N.W.1 (Nov. 3). A graduate assistant in the Junior Technical School of the Wigan and District Mining and Technical College—The Principal, Wigan and District Mining and Technical College, Wigan (Nov. 5). An assistant lecturer in physics in the University of Sheffield—The Registrar, University, Sheffield (Nov. 8). A woman inspector for work in connexion with the agricultural education (including rural domestic economy) of girls and women—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S.W.1 (Nov. 10). An assistant lecturer in education in the University of Leeds—The Registrar, University, Leeds (Nov. 10). A student assistant in the Department of Economics at the Harper Adams Agricultural College—The Advisory Economist, Harper Adams Agricultural College, Newport, Salop (Nov. 10). Two scientific assistants and two technical assistants at the Radio Research Station, Slough—The Secretary, Department of Scientific and Industrial Research, 16 Old Queen Street, S.W.1 (Nov. 11). Inspectors of plants and produce in the Agricultural Department of the Gold Coast—The Private Secretary (Appointments), Colonial Office, 2 Richmond Terrace, Whitehall, S.W.1 (Nov. 17). A plant physiologist in the Department of Agriculture and Horticulture of the University of Bristol, Long Ashton—The Secretary, University, Bristol (Nov. 17). A lecturer in zoology at Armstrong College—The Registrar, Armstrong College, Newcastle-upon-Tyne (Dec. 1). An inspector for Scotland under the Alkali, etc., Works Acts, and inspector under the Rivers Pollution Prevention Act—The Secretary, Department of Health for Scotland, 125 George Street, Edinburgh.

Our Astronomical Column.

Total Solar Eclipse of Oct. 21.—The only available station in the eclipse of Oct. 21 was the tiny island of Niuafo'ou, about midway between Samoa and Fiji. It has the drawbacks that landing is difficult and that the island is subject to volcanic disturbances, a considerable eruption having occurred last year. However, as the sun was high, and totality lasted more than 1½ minutes, it was felt that the opportunity should not be missed, and expeditions proceeded to the island from the Dominion Observatory, New Zealand, and from the United States. The former was in charge of Dr. Adams, the Dominion Astronomer; the following particulars, which he transmitted by wireless, are quoted from the *Times* of Oct. 23:—"There were no clouds and the sky was fair during the eclipse. The photographs taken were satisfactory. There was a faint corona with two long streamers, there were six medium prominences, and Bailey's beads were seen. The whole of the proposed programme was carried out."

Particulars about the American party were announced in a *Daily Science Bulletin* (Oct. 9) issued by Science Service, Washington, D.C. It was sponsored by the U.S. Naval Observatory, and was in charge of Dr. S. A. Mitchell, director of the Leander McCormick Observatory; it was his eighth expedition to a total eclipse; the only failure among the eight was the English eclipse of 1927. At the recent eclipse (1930) he proposed to study the flash spectrum. The largest instrument brought from America was a coronagraph of 63 feet focal length, operated by Dr. Ross W. Marriott, of the Sproul Observatory, and Dr. Weld Arnold. This was to be used both for coronal photographs and for obtaining star positions for the measurement of the Einstein deflection of light. No details of the results obtained by the American party are yet to hand.

The next total solar eclipse is that of Aug. 31, 1932, total near Montreal and in the north-east corner of the United States. It is likely to be observed by a great number of astronomers, as the meeting of the International Astronomical Union is to be held in the United States just after the eclipse.

Reproduction of an Old Crayon Drawing of the Moon.—There is in the Radcliffe Observatory at Oxford a large crayon drawing of the moon, made in 1795 by John Russell, R.A., on a scale of nearly five feet to the moon's diameter. Photographic reproductions of this have appeared in the *Monthly Notices* of the Royal Astronomical Society and elsewhere. It is reproduced in colours in the *Illustrated London News* for Oct. 18 on a scale about one-sixth of the original. Mr. Russell took extreme care to make his picture accurate, and his pencil studies of details of the lunar surface occupied him for ten years. Several of these are also reproduced. In one of them he has given rein to his imagination; there is a well-known *Tête de Femme* at one extremity of the Bay of Rainbows, but the picture makes the likeness to a female figure much stronger than the reality. A modern picture-map of the moon in colours, by M. Lucien Rudaux, is given for comparison; this shows the disc fully illuminated, whereas Russell preferred to portray the gibbous phase, the terminator being near Kepler; he wished to have some shadows visible, to assist in showing the surface in relief.

Discoverer of Pluto.—Mr. Clyde Tombaugh's name has become well known through his discovery of Pluto at the Lowell Observatory last January. The *Scientific American* for October has an article by him. Until 1929 his principal employment was farm work, but his interest in astronomy dates from 1926, when he made his first telescope, an 8-inch reflector; he made quite a good 9-inch reflector in 1928; however, he ceased to be an amateur soon afterwards, for early in 1929 he was given a post at the Lowell Observatory. When the 13-inch Lawrence Lowell telescope arrived, it was placed in his charge to search for the planet the existence of which the late Prof. P. Lowell had foretold. Lowell had expected that it would be as bright as mag. 13; actually Pluto was of mag. 15. Its detection shows the thorough nature of Mr. Tombaugh's search.

Research Items.

The Aryans.—In the October issue of *Scientia* Prof. Pizzagalli publishes a review of recent discoveries in philology in relation to the question of the origin of the Indo-Europeans. In the study of linguistic prehistory the dominant and pivotal view now is that of ethnic substrata—the view that the Aryans, not one people, but a number of tribes speaking different dialects of common origin, advanced, not over an empty country, but among peoples of considerable number and of a certain degree of civilisation. Further, that these did not vanish before the invaders, but survived as a subject population which imposed much of its culture and language on the conquerors. M. Auban has endeavoured to show that Sumerian is an Indo-European language, but, apart from other arguments, this involves acceptance of the view that Indo-European has passed from agglutinative to flexional—a transition of which language affords no evidence. The Indo-European character of the Hittite language has a firmer foundation, as traces of Indo-European are more numerous. As regards a Dravidian origin, Slater holds that it was a species of lingua franca diffused by the commercial relations of the peoples of Europe, Asia, and Africa. This depends upon the view that holds to the Mediterranean origin of the Dravidians, an integral part of a dispersion extending from Ceylon on one side to the Basques on the other. These theories tend to place the centre of dispersal in Asia Minor and Mesopotamia, to reduce the Indo-European element in Indo-European culture, and to assume an agglutinative phase before the flexional which is represented by the Dravidian, Sumerian, and Hittite languages, whereas in reality, these languages and cultures at some stage of their history came under the strong influence of the Aryans in their rôle of conquerors. The Aryans' origin must be looked for somewhere within the range of distribution from the Baltic to the Persian Gulf, probably Iran.

Pedigrees of Retinitis Pigmentosa.—Two pedigrees of retinitis pigmentosa have been investigated by Dr. Usher and published in the *Annals of Eugenics* (April 1930). The pedigree of the first family had not been recorded previously; the second is presented in collaboration with Dr. Shennan, and is an extension of an earlier record by Hine. The former covers six generations, and includes some 243 members; it is of considerable value as an addition to the authentic family histories of this condition, and is a detailed record showing that although the symptoms of night blindness varied slightly in degree, they were remarkably constant in being exhibited very early in life, and that the afflicted members in spite of their defective vision lived to an advanced old age. The second pedigree presents certain unusual features, of which perhaps the most interesting is the late age of onset of the condition; it also appeared that early, and presumably congenital, deafness might be an alternative anomaly of the central nervous system among members of the family concerned. It might be anticipated that different individuals would exhibit variations in the intensity and age incidence of a hereditary condition even in one branch of a family, but it would appear that in this instance both modifying factors are determined by the constitution of the germplasm, and that the latter is quite evenly distributed among the several members of a stock. The first family record is characterised by early onset, which permitted the ultimate development of total blindness; the second is significantly different, in that defective vision was a manifestation of later years, and that blindness was seldom complete. It would therefore seem certain that heredity can not only determine the occurrence of a defect but also regulate with precision the actual rate of its development in the individual.

Lead-poisoning of Water-fowl.—In 1921 thousands of water-fowl died in Louisiana from a mysterious disease which was finally diagnosed as lead-poisoning due to the swallowing of spent shot in areas much frequented by sportsmen. During the past two winters a recurrence of mortality from this cause has been notified (*California Fish and Game*, vol. 16, p. 257, 1930). It is associated with particularly low water levels in the coastal region, which permit shallow-feeding ducks, such as mallard and pintail, to puddle in mud-bottoms which have been plentifully sprayed with scattered pellets by shore-shooters. Post-mortem examination of 18 birds showed the presence in every one of pellets of lead, varying in number from 1 to 24, and in each case post-mortem aspects of lead-poisoning were revealed. The pellets might easily be overlooked in a superficial examination, for frequently they were worn down to mere discs of small size. Death is caused by the assimilation of the comparatively thin outer surface worn from all the shot, and since the toxic action of lead is slow and the bird may retain its power of flight for two or three days after having consumed a lethal dose of shot, cases in which an apparently healthy bird is found carrying a considerable number of shot are explained. Unfortunately, there is still deposited, not only in the shallow waters of Louisiana, but also in those of many other States, lead shot which will continue to kill water-fowl for many years to come, and there is no possibility of employing remedial measures.

Temperature and the Breeding of Marine Animals.—Mr. Sven Runnström in *Bergens Museums Arbök* for 1929 (No. 10) ("Weitere Studien über die Temperaturanpassung der Fortpflanzung und Entwicklung mariner Tiere") continues his valuable studies on the influence of temperature on the reproduction and development of certain marine animals. His previous work on the subject was published in the *Arbök* in 1927, where it is shown that the first developmental stages are much more sensitive to changes of temperature than the later larval stages and the adult. The breeding temperatures arrived at experimentally agree well with those in natural conditions. The present research has to do with Mediterranean-boreal forms and was conducted both at Bergen and at marine stations on the Mediterranean, certain ascidians and echinoderms besides *Mytilus edulis*, the common mussel, being studied. The Mediterranean-boreal forms in the boreal region (the southern limit of which is the English Channel) are nearly all summer breeders, whilst those in the Mediterranean usually breed in the winter and spring, sometimes all the year round. The species studied live under conditions of very varied temperature, ranging from 3° to 27·5°. Except in *Mytilus edulis* the ten species investigated in the boreal region show a normal development from 8° to 23° and typical Mediterranean-boreal forms in the Mediterranean show the same temperature limits. Separate races occur in the two regions, breeding at different times. *Mytilus edulis* breeds in Bergen typically in spring at 4°–16°. In the Mediterranean the form *galloprovincialis* breeds in summer at a temperature of 8°–23°.

New Zealand Mollusca.—The *Transactions and Proceedings of the New Zealand Institute*, vol. 60 (quarterly issue), part 4, Dec. 1929, issued March 1930,

contains two interesting papers dealing with the Mollusca. In the first, Mr. C. E. R. Bucknill ("Further Microscopical Details of New Zealand Loricata") investigates the nerve terminals of various chitons and goes minutely into the structure of ocelli, megalæsthetes and micræsthetes. It is shown that although many of the megalæsthetes are destined to become eyes, a large number in certain forms remain permanently as megalæsthetes, the function of which is to secrete a glutinous substance or merely to excrete moisture, and are protrusible, the micræsthetes having chiefly a tactile function. These last are universally distributed and very simple in structure, outnumbering all other nerve terminals by fifteen to one on an average. In the second paper, "New Species of New Zealand Mollusca from Shallow-water Dredgings, part 1", Mr. A. W. P. Powell describes thirteen new species and founds two new genera—*Benthocardiella*, in the family Condylocardiidae, and *Altispecula*, in the family Cerithiidae—the latter founded on a handsome South Australian deep-water shell with strong axial ribs.

Virus Disease of Plants.—A new method of attack has been used by the workers on virus diseases at the Rothamsted Experimental Station. They have realised that the virus should be studied in the environment in which it is most active, namely, the living host, and Dr. J. Caldwell has recently published results of the first part of his work on the "Physiology of Virus Diseases in Plants" (*Annals of Applied Biology*, vol. 17, pp. 429-443). He has studied the passage of the virus of yellow mosaic in the tomato plant, finding that the movement was inhibited by the treatment of part of the stem with chloroform and was also effectively controlled by steaming an area on the stem. There was no localisation of the virus on one side of the stem as might be expected from movement through vascular tissue after a one-sided inoculation, nor did the virus behave as did red ink or particulate substances, both of which passed across the open xylem vessels of the steamed area. It was concluded that the movement takes place in the living ground tissue of the plant.

Slime Fungi in Soil.—C. Thom and K. B. Raper direct attention to the constancy with which amœboid forms of the Myxomycetæ or slime fungi can be obtained from samples of soil and from the decaying vegetation on the surface of the soil, in a paper in the *Journal of the Washington Academy of Science* (vol. 20, No. 15, Sept. 19, 1930). They suggest that the group of organisms may have been rather neglected in studying the soil population, and that the amœbæ of the soil, which have received very considerable attention from soil workers of the last generation, may usually include a strong representation of this group, especially when the soil temperature is not too high (not above 18° C.). The plasmodia and motile amœbæ observed were generally obtained on mannite agar on which suitable samples of the soil or vegetable detritus had been placed; when sporangia were obtained the genus *Didymium* was usually identified.

Suffolk Mosses.—Thirty years have passed since the Rev. E. N. Bloomfield compiled his list of Suffolk mosses; a recent paper by Mr. A. Mayfield ("The Hepatics, Mosses, and Lichens of Suffolk", *Jour. Ipswich and Dist. Nat. Hist. Soc.*, vol. 1, pt. 2, July 1930, pp. 89-140) brings that list up-to-date. While it may be true that the county has been so well worked for mosses and hepatics that few additions will be made in the future, Mr. Mayfield's intensive study of his own parish, in addition to more extended field work, has yielded such excellent results as to indicate the need for the close study of other small areas in order to determine the distribution of what now appear to be rare species in the county.

Saxifrage Crosses.—A cross between *Saxifraga rosacea* ♀ and *S. granulata* ♂ (Marsden-Jones and Turrill, *Jour. Genetics*, vol. 23, No. 1) has given results of unusual interest. These species belong to different sections of the genus. The *rosacea* was obtained from western Ireland, and the *granulata* from Coulston, Wilts. *S. rosacea* is evergreen, while *granulata* forms bulbils. There are also differences in the shape of sepals, petals, and fruit. The F_1, numbering twenty-six plants, was uniform except for one plant with a tendency to form tubular flowers and poor stamens, and this generation more nearly resembled the male parent in most features. The F_2 and F_3, numbering several hundred plants, also showed great uniformity except for the occurrence of lobed or staminoid petals in certain plants. The absence of segregation led to the conclusion that this hybrid form, which is named *S. potternensis*, was tetraploid. This surmise was confirmed by R. O. Whyte, who publishes an account of the cytology in the same issue of the *Journal of Genetics*. The count of 16 as haploid chromosome number in both parent species is confirmed, while the F_2 hybrids have 32-36. Study of the meiosis in F_2 plants indicates that the doubling takes place through a suspended heterotypic or 'semi-heterotypic' division. Investigation of the ovule, petal, and anther deficiency in flowers of this Saxifrage, as well as in several other genera, leads to the view that such deficiencies are a result of the competition for nutriment between anthers and ovules when they attempt to develop simultaneously instead of, as usual, successively. This is regarded as the state of affairs in, for example, the flowers of *Ranunculus acris*, which are deficient of anthers. If the nutrition level falls below that necessary for the optimum metabolism rate for anthers and ovules in the developing flower, then one of the developmental phases may be affected, producing anther or ovule deficiency or petal deficiency with abnormal floral types.

Orogenic History of Alaska.—The geological history of Alaska involves that of no fewer than five highland areas that are considered to be more or less independent of one another in their mode and time of origin. These are: (*a*) the southern coastal ranges; (*b*) the Alaska range and its continuation into the Alaska peninsula; (*c*) the central highlands of the Yukon-Porcupine area and Seward peninsula; (*d*) the Kuskokwim highland of south-west Alaska; and (*e*) the Brooks range of the north. In the *Amer. Jour. Sci.* for August 1930, J. B. Mertie, jun., summarises the fund of structural and stratigraphical data which is now available, with the view of elucidating the problem of orogeny in each of the above five terrains. For the southern coastal ranges the history may be summarised as follows. *Lower Jurassic:* submergence accompanied by great outpourings of basic lavas, with partial uplift towards the end followed by re-submergence. *Middle and Upper Jurassic:* continued submergence accompanied by granite intrusions. *End of Jurassic:* epeirogenic uplift followed by a period of erosion. *Late Lower or early Upper Cretaceous:* partial submergence, probably with injection of granitic rocks. *Early Eocene:* uplift followed by the formation of coal measures which, later, were deformed. *Pliocene:* regional uplift and mountain building with outflows of basic lavas. *Quaternary:* Continued uplift. Detailed histories on similar lines are given for the other four areas.

Friction on an Aerofoil.—In the October number of the *Proceedings of the Royal Society*, A. Fage and V. M. Falkner describe a determination of the friction on the surface of a Joukowski aerofoil. Three methods were used: in the first, the velocity in the air at a few thousandths of an inch from the surface was found by the aid of very small surface tubes, and the friction calculated from the velocity gradient; in the second, the frictional drag was calculated from the difference between the total drag, estimated from the total-head losses in the wake, and the drag due to the normal pressures on the surface; and in the third, the friction was derived from considerations of the momentum and pressure changes in the boundary layer. The values obtained were concordant to a few per cent. The distribution of friction over the surface was such that it had a maximum intensity at a short distance from the nose, and a second and larger maximum just beyond the first, the relative positions of which on the upper and lower surfaces varied with the incidence. The first maximum was ascribed to laminar flow, and the second to turbulent flow in the boundary layer.

Absorption of Light by Xenon.—The absorption spectra of liquids and solids exhibit wide continuous bands which must be related in some way, which is at present not clear, to the properties of the atoms and molecules of the materials. An investigation of absorption by xenon, which might be expected to give simple results from its inert nature, is described by Prof. J. C. McLennan and Mr. R. Turnbull in the October issue of the *Proceedings of the Royal Society*. The fullest results have been obtained with the gas. The longer of the two resonance wave-lengths for this ($^1S_0 - ^3P_1$) is in the middle of the Schumann region at 1469 A., and at a pressure of a few millimetres of mercury line-absorption takes place there. As the pressure is increased, a band develops with strong asymmetry towards longer wave-lengths, and at fifty atmospheres extends between 1584 A. and 1428 A. The behaviour of xenon is thus similar to that of mercury, with which an asymmetrical development of a band takes place round the singlet-triplet line at 2537 A. in similar circumstances. The important question of whether symmetrical broadening occurs about the $^1S_0 - ^1P_1$ xenon line at 1293 A., as it does with the analogous mercury line at 1850 A., according to the evidence available, is left open. A less complete description is also given of the absorption by the condensed phases of xenon, from which it appears, *inter alia*, that liquid xenon has a temperature of maximum optical density between −10° C. and −110° C.

Theory of Pulling a Synchronous Motor into Step.—In connexion with the problems of the parallel running of alternators and the pulling into step of synchronous motors, the main difficulty in finding mathematical solutions lies in solving the differential equations which express the motion. Lord Kelvin and Prof. James Thomson, so far back as 1876, described an integrating machine for solving differential equations with variable coefficients. Modern electrical and mechanical devices have now made possible the construction of a practical integraph of this type. Dr. Bush and others at the Massachusetts Institute of Technology have perfected such an instrument, which gives the solution in about a minute's time. In the *Journal of the Institution of Electrical Engineers* for September, H. E. Edgerton and F. Z. Zak discuss the problem of what happens when a synchronous motor is pulled into step. The results are put in a simple form, convenient for practical use. The relationships between the values of the field current, the motor torque, and the slip, which determine whether a given load having a definite flywheel effect can be brought into synchronism or not, are found. Numerical examples are given which prove the practical value of the equations they give.

Germanium Monoxide.—Although indications of the existence of the compound GeO were obtained by Winkler in 1886, no systematic investigation of the substance has been made. In the September number of the *Journal of the American Chemical Society*, Dennis and Halse describe the preparation of this oxide, and of the corresponding sulphide, GeS, also described by Winkler. The anhydrous oxide is jet-black and crystalline, stable in air and towards acids and alkalis. Hydrogen chloride and chlorine attack it when heated, forming germanium chloroform, $GeHCl_3$, and $GeCl_4$ and GeO_2, respectively. No evidence of the formation of $GeOCl_2$ was obtained. The sulphide was obtained as a red amorphous powder and in black crystals.

Molecular Weight of Lactalbumin.—Besides casein, the chief protein constituent of cows' milk is lactalbumin, which occurs to the extent of about 10 per cent of the casein. Investigations have shown that the behaviour of casein is very complicated, and it was of interest to see whether the marked instability of casein is also found in the lactalbumin and is a characteristic of milk proteins. In the September number of the *Journal of the American Chemical Society*, Sjögren and Svedberg describe experiments with the ultra-centrifuge which show that lactalbumin is not homogeneous with regard to molecular weight, and thus resembles casein. Experiments on the direct ultra-centrifugal analysis of milk are also described. The values for the molecular weight of lactalbumin varied between 12,000 and 25,000, and it is regarded as probable that lactalbumin is not present in milk but is formed during the process of 'purification', especially by the action of concentrated ammonium sulphate, being produced from a material of molecular weight not exceeding 1000.

The Fractionation of Gliadin.—When wheat flour is kneaded with water, the starch is removed and a protein, gluten, remains. This was separated by Einhoff in 1805 into a portion (gliadin) soluble in alcohol of moderate concentration and a portion (glutenin) which is insoluble. Although much careful work on gliadin has been undertaken, it is not certain whether it is a single protein (as Osborne and his co-workers believed) or not. In vol. 18, part 2 (1930), of the *Comptes rendus* of the Carlsberg Laboratory, a long and detailed account of this problem is given by Hangaard and Johnson. Their experiments, although they have not given a final solution of the problem, lead them to assume that gliadin constitutes what Sörensen calls a coprecipitation system, that is, an association of substances combined in a mutually reversible manner in some way so that the system as regards osmotic respects behaves as a single substance, yet in which an exchange is possible between the components when changes in the state and composition of the solution (temperature, salt content, hydrogen ion activity, etc.) give rise to it. If such a component exchange is given the opportunity of forming a sparingly soluble or insoluble coprecipitation system under the new conditions, it will naturally form and precipitate out. The method of fractionation of gliadin used did not permit of the preparation of the constituents of the coprecipitation system in the pure state, but it was simple and did not appear to affect the fractions in any way.

Aspects of Carbohydrate Metabolism.

I. Blood and Urine 'Sugar'.

THE form in which carbohydrate circulates in the body is glucose: it is frequently of clinical importance to determine the amount of this substance in the blood, but estimation of blood-sugar may not be synonymous with determination of blood-glucose. Different methods of estimation give somewhat different results, but this is of little importance clinically, provided the same method is always used. It is, however, of some interest to inquire into the causes of these discrepancies and a certain amount of work has been recently devoted to this subject. After fermentation with yeast, blood still gives a residual reduction with oxidising agents, which is obviously not due to glucose: according to I. M. Rabinowitch (*Biochem. Jour.*, vol. 22, p. 753; 1928) the amount of the non-fermentable reducing substances present in normal or diabetic human blood is about 0·025 per cent expressed as glucose. It is very constant in the same individual, is not affected by insulin or by the administration of glucose by mouth, and is the same in venous as in arterial blood: in all these respects it shows a marked contrast with glucose.

F. K. Herbert, M. C. Bourne, and J. Groen have investigated the nature of the non-glucose reducing substances in human blood (*ibid.* vol. 23, p. 339; 1929: vol. 24, pp. 291 and 299; 1930). In the first paper the distribution of reducing substances between plasma and corpuscles was determined by several different blood-sugar methods. By those of MacLean, Hagedorn and Jensen, and Benedict, there appeared to be more sugar in the plasma than in the corpuscles; by those of Folin and Wu and Shaffer and Hartmann (as modified by Somogyi) the distribution was approximately equal; whilst when the Hagedorn-Jensen method was carried out on the Folin-Wu blood filtrate, there appeared to be slightly more in the corpuscles than in the plasma. Blood filtrates prepared by the tungstic acid method from whole blood or corpuscles reduced the Folin-Wu copper reagent in the cold, but not those from plasma; nor was such a reaction given by filtrates prepared by the use of colloidal ferric hydroxide or zinc hydroxide.

It appears, therefore, that the corpuscles contain non-glucose reducing substances which are precipitated by iron and zinc hydroxides but not by tungstic acid: they are not fermentable with yeast. The most important of these is probably glutathione, since uric acid, creatine, creatinine, and ergothioneine are present in too small concentrations to affect the estimation of blood-glucose. In the second paper of the series it was shown that when pure glutathione was estimated in the presence of 0·1 per cent of glucose, it produced a reduction of 56 per cent of that given by a corresponding amount of the latter when the Hagedorn-Jensen method was used, of 39 per cent with the Shaffer-Hartmann method, and of 20 per cent with that of Folin and Wu: it failed to affect Benedict's reagent. It was also shown that a zinc hydroxide filtrate, provided the precipitation had been carried out at a slightly alkaline reaction, contained none, whilst all the glutathione present passed into a tungstic acid filtrate. The third paper applies these results to blood, and a description is given of a new method of precipitating the proteins: the corpuscles are kept intact by using sodium sulphate as diluent instead of water, the precipitation being carried out by means of tungstic acid. The four methods of blood-sugar estimation agreed when compared on zinc hydroxide or the modified tungstic acid filtrates; on the original tungstic acid filtrates higher values (except with Benedict's method) were obtained and the methods disagreed. The discrepancies could all be explained by the known reducing powers of glutathione in the presence of the reagent used. The amount of this substance in the blood is about 0·05 per cent, a higher figure than that given by Rabinowitch.

J. M. Gulland and R. A. Peters (*ibid.* vol. 24, p. 91; 1930) have investigated the nature of the reducing substances in pigeons' blood. The Hagedorn-Jensen method was used: relatively high values for blood-sugar were obtained, but it was found that even after the injection of insulin, or after the blood had been exposed to anaerobic glycolysis, a residual reduction of 0·07 per cent was still observed. Deduction of this figure from the 'blood-sugar' value indicated that the true glucose of the blood was not very much higher than that of mammals. The residual reducing substances were almost confined to the corpuscles: about half of them reduced the ferricyanide in the cold, suggesting the presence of sulphydryl groups. It was found that, by this method, the reducing power—in terms of glucose (100)—of uric acid was 53, of glutathione 17, and of ergothioneine 56; by the ordinary Hagedorn-Jensen method glutathione was found to be equivalent to 45 of glucose (agreeing with Herbert *et al.*). From these estimations, and others carried out on tungstic, trichloroacetic, and zinc filtrates, it was concluded that the non-glucose reducing substances in pigeons' blood are ergothioneine, uric acid, creatinine, creatine, and one or more unidentified compounds, possibly a purine-carbohydrate or a phosphoric ester.

E. N. Allott (*ibid.*, vol. 22, p. 773; 1928) has shown that the rates of utilisation of α, β, and $\alpha\beta$ glucose when injected into the veins of rabbits are the same. O. J. Nielsen (*ibid.*, vol. 22, p. 1490; 1928), by estimates of the blood-sugar at intervals of 1–5 min., has shown that it is not, in man, subject to violent fluctuations, remaining fairly constant or falling or rising steadily according to the conditions at the moment: the observations were carried out after fasting and after the ingestion of food or glucose on both normal and diabetic subjects.

Two other papers on carbohydrates may be referred to briefly here. C. Rimington (*ibid.*, vol. 23, p. 430; 1929) succeeded in isolating a carbohydrate derivative from alcohol-denatured serum proteins, by hydrolysis with baryta, treatment with lead acetate, and precipitation with ammonia: the lead ammonia precipitate was dissolved in weak acid, the lead removed, and the filtrate treated with mercuric chloride solution: after removal of metals the solution was concentrated and the carbohydrate precipitated with methyl alcohol and ether. The yield was 2 per cent. On analysis it was found to contain 4·1 per cent nitrogen, and molecular weight determinations indicated that it was a disaccharide, having the empirical formula $C_{12}H_{23}O_{10}N$; further investigation showed that it was a disaccharide of glucosamine and mannose. Both albumin and globulin yielded the same derivative, and it was also obtained after tryptic digestion of serum protein. It is considered probable that the mannose is attached to the nitrogen atom of the glucosamine. From the amount present the minimum molecular weight of the albumin or globulin must be of the order of 17,000, a figure which agrees with estimations made by other methods. It is possible that this carbohydrate plays some part in the immunological reactions of the plasma proteins.

H. Sobotka and M. Reiner (*ibid.*, vol. 24, p. 394; 1930) have investigated the configuration of certain sugars by means of the differences in their reducing powers for the ferricyanide reagent of Hagedorn and Jensen. Their results lead to the conclusion that in aldo- and keto-hexoses the configuration between the third and fourth carbon atom is the determining factor: in aldopentoses the configurations between these two atoms and the second and third share the influence on the reducing power. The *trans* arrangement of OH is more active than the *cis*.

The question of the nature of the reducing substances in urine, especially in human beings, has always aroused interest. It is generally held that small amounts of glucose are normally excreted; during lactation, lactose may appear, whilst the excretion of a pentose is a rare abnormality. J. Patterson (*ibid.*, vol. 20, p. 651; 1926) considers, however, that the carbohydrate in normal urine is not glucose, since it is not fermented by baker's yeast and forms a phenylosazone of different crystalline form and properties from those of glucosazone, although its analysis suggests that it is a hexosazone. Hydrolysis of urine usually sets free a fermentable reducing sugar. A. Hassan, however, considers that glucose is present in normal urine, although accompanied by another sugar which forms a different osazone (*ibid.*, vol. 22, p. 1332; 1928). Both authors agree that interfering substances must be removed before attempting to form an osazone; Patterson employs the mercuric nitrate reagent and Hassan charcoal. The latter author also found that the number of urines giving typical glucosazone crystals as well as mixed crystals, instead of the latter only, was increased following a meal but not following the administration of glucose alone.

Social Biology.*

DARWIN'S "Descent of Man" was a challenge to the complacent dualism which had permitted utilitarian science and humanistic philosophy to pursue an independent course from the days of the schoolmen to the middle of the nineteenth century. To-day it is evident that the social sciences can no longer progress within the framework of a philosophical tradition brought into being by the conditions of the city State and nurtured from Abelard to Kant in servile association with the requirements of apologetics. Economic science has already severed its moorings to moral philosophy. There is a growing disposition among other branches of social science to do the same. To-day the application of scientific method to the study of human society is philosophically guaranteed by the generally accepted conclusion that millionaires and metaphysicians, statesmen and seventh-day adventists are products of the same secular agencies as have fashioned the rest of the brute creation. The far-reaching implications of the change in outlook which Darwin's doctrine has brought about are becoming more apparent in our time, because biologists are now undertaking the analysis of the characteristics of conscious behaviour in animals and the behaviourist school of psychologists is applying the new methods to man himself.

Man is an animal as the ant is an animal. The biologist as a biologist confines his attention to those characteristics which ants and antiquarians have in common. The sociologist confines his inquiries to certain characteristics which distinguish men and women from ants and all other animals. Their respective fields of investigation overlap in the attempt to define what characteristics of human society are determined by those characteristics which men share with all other animals and what characteristics of human society are referable to characteristics which distinguish man as one species of animal from all other species of animals.

We must be prepared to recognise that issues which made the first claim on the attention of men like Huxley, Galton, and Spencer are no longer topical. The misguided opposition of the Churches compelled biologists of Darwin's generation to concentrate on emphasising the characteristics which we share with other animals. Social biology has now to undertake the task of defining in biologically significant terms the characteristics which distinguish man as one species of animal from all other species of animals. The work of physiologists like Sherrington and Pavlov is opening the way to a biological interpretation of those peculiarities which are most diagnostic of the human species. A well balanced view of the rôle which inheritance and social tradition respectively play in determining differences which distinguish different social groups will only be possible when the biological study of behaviour and the methods of the geneticist can be brought into working harmony.

The great danger lies in undue haste to establish conclusions which may be made the basis of legislation. The genetic basis of occupational and racial stratification in human societies is a problem which calls for discipline, detachment, and restraint. Nothing could make the exercise of these wholesome virtues more difficult than to bring issues which are still problematical to scientific workers before the forum of political controversy. Much research directed to elucidate genetic variations in human communities has been vitiated by a failure to envisage the complexity of the problem. A genuine scientific analysis of genetic variation in human society must be sustained by the recognition that human society is a unique biological phenomenon, inasmuch as the family is a unit for the cumulative communication of old and new environmental stimuli as well as a group delimited by genetic affinity. The pre-eminent need of the moment is investigation rather than propaganda. The first task of the social biologist is not to advocate the sterilisation of the unfit but to undertake the sterilisation of the instruments of research before operating on the body politic.

In our own generation the population problem embraces a variety of issues in which the sociologist and the biologist have a common interest. A clear appreciation of the biological issues necessitates the prosecution of research into the physiology of reproduction, the genetic basis of human behaviour, and the incidence of changes in fertility. The analysis of this intricate problem will not be facilitated by an unduly alarmist attitude. The sceptical inquirer may approach the differential fertility of the social classes which has accompanied the decline in the birth-rate as a conundrum rather than a catastrophe. We have inadequate scientific evidence to justify the belief that extensive genetic differences do distinguish the social classes. If we had such knowledge it would be necessary to ascertain how such differences are transmitted before justifying the belief that a temporary disparity in fertility will necessarily produce

* Substance of an inaugural lecture delivered by Prof. Lancelot Hogben at the London School of Economics and Political Science on Oct. 23.

significant social consequences. The German and Swedish data suggest that contraceptive practice is rapidly spreading to all sections of the community, so that differential fertility may be a problem which will solve itself without legislative interference. On the other hand, if this transpires to be the case, it is possible that European communities will be faced with a rapid decline in general population, which will create a new constellation of social problems for legislative treatment. The decline in the birth-rate brings us face to face with the fact that human society is entering upon what Mr. J. B. S. Haldane has called the era of biological invention, and the institution of a chair of social biology is an implicit recognition of the impending change. The rapid progress now being made in physiology makes it unlikely that in the near future human society will be in a position to regulate the reproductive process to an extent and in ways hitherto unimagined and unimaginable.

In many directions it will be necessary for the social biologist to co-operate with pure sociology in ascertaining the significant factors which operate in determining the growth of human populations. On the other hand, social biology cannot develop fruitfully if it isolates itself from the methods of experimental inquiry. By the very complexity of the genetic problem social biology is committed to create a framework of biological research and teaching in which a new type of social psychology can develop. For the same reason it is entrusted with the experimental analysis of aspects of the physiology of reproduction too long neglected by medical science.

Periodicity of Locust Invasions.*

WHILE the technical methods of controlling locusts are well developed and very effective, a successful organisation of anti-locust campaigns meets with many difficulties. The main difficulty lies in the fact that locusts are not a permanent pest, but may be absent from a country one year, and appear in enormous swarms in the next. For example, the Desert locust, a species alluded to in the Bible, invaded the whole of north and east Africa, Persia, India, Iraq, Palestine, and Turkey in 1914–16 and then nothing was heard about it for more than ten years. In 1926–27 a new outbreak started, and by 1929–30 Africa from Tanganyika to the Mediterranean, and south-west Asia so far north as Transcaucasia and Turkestan, were overrun by devastating swarms.

Such sudden outbreaks involving whole countries find some of them not fully prepared to meet the danger, and during the recent invasion extraordinary efforts were required to save the crops. An effective organisation of an anti-locust campaign cannot be improvised at a moment's notice, while it is clearly impossible to keep the organisation in readiness during long intervals between invasions.

The key to the solution of the locust problem is therefore to find out the laws governing periodic outbreaks of locusts. Recent work in this direction in Russia, South Africa, Sudan, and elsewhere proves that the periodicity of locust outbreaks is intimately connected with the fact that all known species of locusts occur in two forms or phases. These forms differ from each other in a number of structural and colour characters, but more particularly in the habits. During the intervals between outbreaks locusts are represented by the solitary phase, which is a harmless grasshopper without definite social habits. When the outbreak begins, the solitary phase is transformed into the gregarious one : the individuals of this phase form dense swarms and undertake long migrations. Experimental work on phases has shown that the solitary phase can be turned into the gregarious one, if the locusts are kept in a crowded condition ; conversely, one can obtain the solitary phase by breeding gregarious individuals under isolated conditions.

Periodic outbreaks of locusts depend, then, on the cyclic transformation of these insects from one phase into another, and back again. The actual factors causing and favouring the transformation are still insufficiently known, but it is clear that the problem of the successful control of locusts cannot be solved until these factors are thoroughly investigated.

A special Committee has been appointed recently by the Government to consider the locust problem, and it was decided to organise exhaustive investigations into the question of periodic outbreaks and their causes. It is hoped that the actual work will begin shortly, and this concentrated scientific attack on locusts should produce results of great practical value in the shape of means of foreseeing and preventing locust invasions, which would mean an enormous saving in crops, human energy, and money for a large number of countries affected by the plague.

* Substance of a paper read by Dr. B. P. Uvarov before Section D (Zoology) of the British Association at Bristol on Sept. 9.

Research in the Electrical Industry.

MR. C. C. PATERSON, president of the Institution of Electrical Engineers, gave his inaugural address on Oct. 23. His subject was research, and he illustrated it with many brilliant and novel experiments. It rivalled the address on ' pressure rises ' given by the late W. Duddell in 1913, when many interesting experiments were shown. He pointed out that whichever way we look in the domain of electrical engineering, whether in lighting or heating, in electro-chemistry or electro-medicine, in radio-telephony, in photo-electricity, or in heavy engineering, there are new advances every day, and dramatic discoveries and achievements rapidly succeed one another. As each discovery from the researches of physicists, metallurgists, and chemists comes to the engineer, he tries to assimilate it and turn it to practical use. There is a serious risk, however, of treating the old problems—often only half understood—as if they are already solved. Engineers are too often content with the knowledge of the art as they find it, and allow new extensions of the industry to be built on an insecure foundation of half-truths and empiricism. The old subjects need research as much as the new, and the most difficult problems are often those which the last generation has thrown aside in its hurry to grasp and exploit the next new thing. Mr. Paterson advocated research on many of the old-established usages in the industry. In his opinion, this would open up many new avenues of advance.

Mr. Paterson said that the distinction between pure and applied research is only one of ultimate

object. The ideal which inspires every one working in research is the substitution of knowledge for empiricism, and this finds as true an expression in industry as in those research institutions where the labours are furthest removed from practical utility. The measure of purity of research is determined by the spirit of the worker. He who uses his research talents in order that he may gain the prestige of priority in discovery is no more exalted than he who seeks to understand enigmas which are preventing a product from becoming useful to mankind. The desire to explain the mysteries of the world is the impulse of the researcher; it is the way in which the knowledge is used that purifies or debases. Empiricism has an essential place in almost every industrial process, because schedules and specifications can only be based on theory and principles so far as these are known, and the rest has to be rule of thumb. In addition, the schedules must be such that people who operate them need only follow them blindly and empirically. As an example, Mr. Paterson mentioned the controversy about the permissible voltage variations at a consumer's terminals: he pointed out that the effect of increasing the permissible variations would be to neutralise much of the good work done by manufacturers. He suggested that there should be a joint examination, by the supply industry and the manufacturers, of the problem.

Speaking of the problem of electric heating, Mr. Paterson considered it is largely a metallurgical one. The alloys used for the resistance wires are generally of nickel and chromium. These alloys are suitable because the oxide layer formed on their surfaces when heated in air is highly protective. Once a certain thickness has formed, further oxidation of the underlying metal proceeds very slowly. The suitability of an alloy is determined by the protective and adherent properties of the oxide rather than by the properties of the alloy itself. So far as progress in electric lighting is concerned, the luminous efficiency of the modern tungsten filament gas-filled lamp is not likely to be greatly exceeded. The actual efficiency is about 18 lumens per watt, where 12·57 (4π) lumens are emitted by a uniform point source of one candle power. Theoretically, 670 lumens per watt could be obtained by transforming power directly into light of maximum visibility. The light obtained, however, would be monochromatic. It would be quite unsuitable for general illumination, as it would be of a yellowish-green hue. Mr. Paterson showed a gaseous discharge tube, first tried in the United States and developed by Prof. Pirani, of Berlin, which operates at ordinary voltages and gives an efficiency up to 50 lumens per watt. He showed that if we use two of these tubes, one filled with sodium and the other with neon gas, the combination gives a light akin to candle-light. If we add a mercury vapour tube we get a fair approximation to daylight. There is room for progress to be made in this direction.

African Ethnology and Archæology.

SEVERAL communications from field workers in Kenya, Rhodesia, and South Africa were made to Section H (Anthropology) of the British Association at the recent Bristol meeting. Mr. L. S. B. Leakey gave a detailed account of the system of land tenure among the Kikuyu. One great cause of misunderstanding between the incoming white races and the natives is the different way in which each looks at the ownership of land; and it was felt that such studies as that made by Mr. Leakey, who speaks Kikuyu and has worked with Kikuyu people for many years, should help to bridge this gulf.

Mr. Leakey also gave an illustrated account of the pottery found with stone age cultures in Kenya. A striking feature is the discovery of pottery *in situ* in the lower part of the Upper Aurignacian deposits, at a depth of 28 feet from the original modern floor surface, and beneath a big series of undisturbed strata. Associated with the pottery were tools of a Mousterian type, an industry belonging in Kenya to the second division of the Gamblian pluvial just after its maximum. In view of the absence of pottery finds in Europe in association with Palæolithic cultures, the discovery opens again the question as to whether pottery may yet be found in other regions associated with Aurignacian implements; the evidence at present is entirely negative.

Mr. Leslie Armstrong, in a paper on "The Age of Man in Africa as demonstrated at the Victoria Falls", referred to a letter from Col. Fielden which was published in NATURE of Nov. 23, 1905, p. 77, directing attention to the "stone implements . . . present in profusion, both in the river gravels on the highest margins of the Zambesi valley and also spread broadcast, along with rolled gravel, on the basalt platforms of the ancient river channel below the Victoria Falls". Later, Mr. G. W. Lamplugh and Mr. Henry Balfour published papers on these implements. In 1929 Mr. Armstrong and Mr. Neville Jones of Buluwayo, as part of the work of the Rhodesian Archæological Expedition, investigated the occurrence and the zones of distribution, and were able to suggest the relation of the various types of artefacts to successive stages in the cutting back of the gorge.

The sequence of types was found to be precisely the same as in Europe. The earliest are pre-Chellean and occur in a more or less rolled condition over the whole area examined, which extended from the present falls to the fifth gorge. Beyond the fourth gorge, only tools of this type occur and they were obviously left there by the river when the position of the falls was on the line of the fifth gorge. Similarly, Chellean, Acheulean, and Mousterian tools occur in succession back to the area of the first and second gorges. Since the pre-Chellean tools were deposited by the river, the gorge, which is nowhere less than 400 ft. in depth and 100 ft. in width, has been excavated by the Zambezi for a distance of five miles by the opening out of lines of faulting and shrinkage cracks in the basalt. A long period of time must be allowed for this erosion. But there is geological evidence that the erosion was not continuous and that there was an arid period when the Zambezi river was almost, if not completely, dried up, and at least one arid and one pluvial period have occurred since the implements of Acheulean type were dropped by their users near the river and washed into the gravels. Mr. Armstrong therefore concludes that the African series of lower Palæolithic stone implements is probably a whole period earlier than their European parallels, basing his belief on the equation of the pluvial periods of Africa with the glacial epochs of Europe.

A paper approaching the problems of the history of the south-eastern Bantu from a new point of view was read by Mr. A. J. H. Goodwin. He has worked among the AmaMpondo, and studied their royal regimental system. This system is based on the fact that when the 'Great Wife' of a chief is chosen, generally from the point of view of the value of her family as allies, her

son is heir to the chieftainship, and voluntary retainers attach themselves to him, thus forming the nucleus of a royal regiment. Mr. Goodwin gave details of the generation-regiments of the AmaMpondo, and showed how such details might be used as evidence for dating battles, since native historians carefully remember the names of the regiments present at battles. The Rev. W. A. Norton has attempted to date the regiments of the Ba Suto, but as yet nothing of this sort has been done for the south-eastern Bantu. Mr. Goodwin's paper also interested ethnologists, since it forms another link binding the eastern Bantu into a whole, the generational regimental system being well known everywhere farther north.

Action of Cinchona Alkaloids in Malaria.*

ALTHOUGH three centuries have elapsed since cinchona bark was introduced into European medicine for the treatment of malaria and it is nearly a century since the last of the four alkaloids—quinine, quinidine, cinchonine, and cinchonidine—which form the active constituents of the bark was discovered, there are still numerous problems to be settled in connexion with the use of the bark and its constituents in malaria. Until recently, chemotherapeutical work in this disease has been hampered by the fact that the relative values of drugs could only be investigated by extensive clinical trials in malarial countries. Much work of this kind has been done in India and Malaya by MacGilchrist, Acton, Fletcher, Sinton, and other British experts in tropical medicine, mainly to ascertain whether the present policy of concentrating on quinine as the only valuable cinchona alkaloid for the treatment of malaria is sound. Work of this kind is expensive and difficult, and final conclusions have not yet been reached.

Birds share with man susceptibility to malaria, and in recent years a method has been worked out of using them for testing new anti-malarial drugs. Facilities for such tests having been provided in Great Britain by the Chemotherapeutical Committee of the Medical Research Council, Dr. Henry, in association with Mr. J. A. Goodson, has been able to have the four cinchona alkaloids referred to above, together with a large number of their chemical derivatives, tested by Dr. Macfie in bird malaria. The results of this preliminary work support the conclusions arrived at from clinical trials that quinine and quinidine are more efficient than cinchonine, but the value of cinchonidine is still uncertain. Of the derivatives of quinine tried, the most promising is hydroquinine, which in these preliminary tests gave better results than any other drug examined. On oxidation, quinine is converted into an acid, quitenine, which is inactive in malaria, but it has been shown that activity is regained when the acid is esterified, and that in a series of such esters activity is slowly increased as the series is ascended, until at butyl and amyl esters the preparations begin to be curative instead of merely retarding the development of the malarial parasite.

In various tropical parts of the British Empire other drugs than cinchona enjoy local reputations as cures for malaria; for example, Alstonia bark in West Africa, the Far East, the Pacific Islands, and sub-tropical Australia, akuamma throughout Africa, and greenheart bark in British Guiana. All these also contain alkaloids, which have been tried in the course of this work, but the Alstonia alkaloids alone have shown any activity in bird malaria.

*Substance of a paper read by Dr. T. A. Henry before Section B (Chemistry) of the British Association at Bristol on Sept. 18.

University and Educational Intelligence.

CAMBRIDGE.—Sir James Jeans will deliver the Rede lecture at 5.30 P.M. on Nov. 4, taking as his subject "The Mysterious Universe".

The Appointments Committee of the Faculty of Engineering has appointed R. H. Angus, of Sidney Sussex College, to be University demonstrator in engineering.

The Appointments Committee of the Faculty of Physics and Chemistry gives notice that the Humphrey Owen Jones lectureship in physical chemistry is vacant owing to the appointment of Dr. E. K. Rideal to be professor of colloidal physics. Intending candidates for the Lectureship should send their names to the chairman of the Faculty Board of Physics and Chemistry, the Master of Pembroke College, not later than Nov. 12.

The Managers of the Balfour Fund, with the approval of the Faculty Board of Biology 'A', have made a grant of £150 from the fund to L. C. Beadle, of Pembroke College, for research on the biology of the East African Lakes.

EDINBURGH.—Sir James Barrie was installed as Chancellor of the University on Oct. 25 and conferred honorary degrees on Sir Thomas Holland, Principal of the University, and Sir J. J. Thomson, Master of Trinity College, Cambridge, among others.

LONDON.—The title of emeritus professor of electrical engineering in the University has been conferred on Prof. Ernest Wilson, on his retirement from the University chair of electrical engineering at King's College.

THE Council of the Institution of Naval Architects has awarded the Yarrow Scholarship in Marine Engineering (1930) to Mr. W. J. Reynolds, of Messrs. Alexander Hall and Co., Aberdeen. The Scholarship is of the value of £100 per annum and will be held at the University of Glasgow for four years.

"THE day of science is here in commerce as in industry." These words sum up the purport of Sir Francis Goodenough's paper read before section L (Education) of the British Association at Bristol on the subject of "Education for Business." No greater service could be rendered by the Association at this time than to promote the general recognition of the truth that scientific methods are imperatively demanded alike in the fields of production, management, and marketing. Scientific research is needed not only into methods of manufacture, handling and transport and methods of management, but also into methods of selling and the possibilities and requirements of the world's markets. In technical education for production there has been a great advance in the past twenty years, but education for marketing has not kept pace. Commerce has not hitherto been recognised as a science, and this vitally important business has been regarded too much as something people can 'pick up' as they go along. In the highly competitive and increasingly scientific world of to-day, it is essential that British commerce should find recruits endowed with "character *plus* brains raised to the highest power by education". There must be a general recognition of these facts and a determination on the part of all concerned to raise high the standards of efficiency and probity in the conduct of British commerce, to the benefit of all engaged in it and to the credit of the nation as a whole. So will be dissipated the still surviving prejudices which have for generations imposed a social handicap on those who follow a 'commercial' career and operate despite the congestion existing in other professions mistakenly regarded as more honourable.

Historic Natural Events.

Nov. 2, 1664. Great Plague of London began.—For some years London had been almost free from the bubonic plague, but an outbreak of great intensity began in the autumn of 1664, probably spreading from Holland. The first cases occurred on Nov. 2, and a few more in the following winter, which was severe. In May 1665 the epidemic became more noticeable and spread slowly through the City. The numbers of deaths reported from this cause were 43 in May, 590 in June, 6137 in July, rising to 31,159 in September. The total number reported was more than 68,000, and there were probably many thousands more which were kept secret. The population of London at the time was less than half a million, and of these, two-thirds fled to escape the contagion (incidentally spreading it widely over the country), so that of those who remained, nearly half died. The condition of London on Sept. 20, 1665, was described by Pepys: "But Lord! What a sad time it is to see no boats upon the River; and grass grows all up and down White Hall court, and nobody but poor wretches in the streets!" It was not until the cold weather of November and December 1665 that the plague abated and the refugees returned.

Nov. 2, 1898. Floods in the Lake District.—As a result of heavy rains during a gale on Nov. 2, one of the worst floods on record occurred in the Lake District. At Kendal 3·6 in. of rain fell in two days, and the Kent rose 12 in. higher than the previous highest level of 1878, flooding the town to a depth of four or five feet and doing great damage. At Keswick nearly three inches fell in 24 hours, and Thirlmere being already at its full height, the water overflowed through Keswick, where many houses were flooded. Throughout Cumberland and Westmorland similar scenes occurred—bridges damaged or washed away, animals and poultry lost. At Cockermouth the Derwent rose to the highest point since the great flood of 1852 and the lower parts of the town were deeply flooded. Windermere reached a level a foot higher than the previous record.

Nov. 3, 1927. New England Floods.—As a result of strong south-easterly winds blowing from the Atlantic, torrential rains fell over New England and eastern New York, exceeding 9 in. in several places. The ground was already saturated by excessive rain in October, and so heavy and extensive were the rains of Nov. 3 and 4 that destructive floods occurred even before the rain had ceased. The rivers exceeded their previous highest levels by several feet. At Montpelier, Vt., for example, the Winovski rose 16·5 ft. and there were 8-10 ft. of water over the whole business district. At White River Junction, Vt., the Connecticut rose 29 ft. in 24 hours. The greatest floods occurred at night, and the damage was estimated as more than 37 million dollars, more than 9000 persons were rendered homeless, and 88 lives were lost. Both life and property would have suffered far more but for the Weather Bureau warnings.

Nov. 4, 1926. Storm and High Tide on West of Scotland.—An unusually deep barometric depression travelled along the north coast of Ireland and north-eastward across Scotland on Nov. 4 and 5, causing severe gales. On the west coast of Scotland there was a very high tide. Many rivers overflowed their banks and caused considerable damage by flooding; roads were rendered impassable, in some cases railway services were delayed, and the telephone and telegraph services were dislocated.

Nov. 5, 1530. North Sea Storm.—On Nov. 4–5 a violent wind blew down many houses and trees in England. It was followed by a great inundation of the sea, which invaded the coasts of Essex and Kent and the Isle of Thanet, and was even more destructive in Flanders, Zealand, and Holland, where 25 towns and 24 smaller places were wholly or partly destroyed; Antorf and Antwerp suffered severely.

Nov. 6, 1909. Heavy Rain in Jamaica.—During the occurrence of an unusually strong northerly wind ('norther'), very heavy rains were experienced in the north-eastern part of the island, especially on Silver Hill. In eight days, Nov. 4-11, the total recorded was 135 in., of which 30·5 fell on Nov. 6. The rivers and gullies leading from the mountains were flooded, with much loss of property and some fatalities. At Radnor there was an immense landslide, which blocked the gorge of the Cascade River and raised the level of the water by 200 ft.

Nov. 6, 1916. Optical Phenomena near Amiens.—About 9.30 P.M., at Pont Noyelles, east of Amiens, there was a lunar halo of 22°, a horizontal circle or mock moon ring, and a halo of 90°. During the remainder of the evening gun flashes appeared as narrow vertical streaks centred 10° to 15° above the horizon, and a large red glow from a fire some miles away also appeared as a very large and fiery streak with a dark space at its centre, 32½° above the horizon. The appearance was described as "the Angel Gabriel crossing swords with the powers of darkness".

Societies and Academies.

PARIS.

Academy of Sciences, Sept. 22.—The president announced the death of Philippe Glangeaud, of the Section of Mineralogy.—**H. Vincent**: The comparative cryptotoxic power of the sodium salts of some of the saturated fatty acids. It has been shown in earlier publications that minute doses of sodium oleate, palmitate, or margarate can neutralise very active toxins (tetanus, diphtheria, dysentery), and that this is due to a physical action of the soaps. The antitoxic power of these soaps extends also to venoms, certain alkaloids, and metallic salts. The present communication gives an account of the antitoxic properties of the lower terms of the fatty acid series. The effects are very irregular and do not depend on the number of carbon atoms in the molecule, the solubility, or the melting point of the acid. There is no connexion between the cryptotoxic power and the surface tension of the solution.—**Luc Picart**: The singular cases in the calculation of orbits.—**R. Chodat**: New researches on the gonidia of lichens.—**C. Raveau**: The utilisation of streams at the mouth.—**Jacques Chokhate**: Continued algebraical fractions.—**Paul Alexandroff**: The geometrical analysis of the dimension of closed ensembles.—**Georges Giraud**: The integro-differential equations in conjunction with integro-differential conditions at the boundary.—**Radu Badesco**: A functional equation.—**Pierre Dupin**: The vibration of cylindrical tubes in water under the influence of alternating vortices.—**D. Rosenthal** and **M. Mathieu**: Mild steel welding in the electric arc. The strength of the weld is much increased if during the welding the metal is protected from oxidation. Examination by X-rays proves the existence of stresses in the case of the non-protected welds.—**Constantin Salceanu**: The magnetic double refraction of phenol, naphthalene, and of phenanthrene in the fused condition. The passage from the benzene ring to naphthalene and phenanthrene results in a large

increase in the magnetic double refraction.—**A. P. Rollet**: A silver borate. The compound described was proved to have the composition $Ag_2B_4O_7 + 2H_2O$. —**André Meyer** and **Mlle. Suzanne Mathey**: The volumetric estimation of acetone. The acetone is precipitated as $3HgSO_4 . 5HgO . 2C_3H_6O$ by Denigès reagent (acid mercury sulphate), the mercury in excess being titrated by Volhard's method.—**L. Bert**: A new method of synthesis of phenylpropargyl alcohol and its homologues substituted in the ring. With commercial cinnamyl alcohol as a starting point, a method giving good yields of phenylpropargyl alcohol is outlined.—**H. Mémery**: The summer of 1930 and the solar variations.—**W. Moycho**: The formation of the pigment in *Bacterium prodigiosum*. The pigment (prodigiosine) always appears at the period of the strongest development: it is formed at the death of the bacterium and oxygen is necessary for its appearance.—**G. Dinulescu**: The biology of the horse-fly.—**Edouard Ducloux** and **Mlle. Georgette Cordier**: Researches on the treatment of experimental bovine anaplasmosis in Tunis. This disease is curable, provided that the treatment is commenced sufficiently early.

Leningrad.

Academy of Sciences (*Comptes rendus*, No. 5, 1930).—**A. Archangelskii**: Investigations of phosphorite deposits in Russia.—**A. Borisiak**: *Ursus spelœus rossicus* nov. n. Description of a new race of *U. spelœus* from five almost entire skeletons found in a cave near Krasnodar, northern Caucasus.—**P. Lazarev** and **N. L. Rodzevic**: The phenomena of ionisation of gases during the photochemical reactions in solids.—**A. Rolmačev**: Some unexpected floristic finds in the central region of the Taimyr peninsula.—**N. Vassojevič**: Geological investigations in the region of the Djava mineral waters, southern Ossetia.—**K. Flerov**: The white muzzle deer (*Cervus albirostris* Przev.) as the representative of a new genus *Przewalskium*. A full description of the new genus.—**E. Cheissin**: A contribution to the binomics of infusoria parasitic in various invertebrates of the Lake Baikal.

Comptes rendus, No. 6, 1930.—**A. Vinogradov** and **M. Neustrueva**: Manganese in insects (2). Quantitative determinations of manganese in a series of insects.—**A. Zachvatkin**: Vertical distribution and diurnal migrations of the zooplankton in Lake Baikal.—**A. Birula**: A preliminary communication on the Quaternary Carnivora of Crimea. Sixteen species are recorded from the Quaternary palæolitic deposits in Crimea, while the present-day fauna contains only seven.—**A. Kovanko**: A class of periodic generalised functions.—**N. Bogoliubov**: Approximation of functions by trigonometric summations.—**V. Ambarcumian**: A deduction from Dirac's theory of protons and electrons.

Sydney.

Linnean Society of New South Wales, Aug. 27.—**J. McLuckie**: On *Grevillea Gaudichaudii*, a supposed natural hybrid between *Grevillea laurifolia* and *G. acanthifolia*. The relation of the hybrids to the parents is shown by a graph based on the coefficients of divergence from the midparental reference point. —**F. A. Craft**: (1) The topography and water supply of Cox's River, N.S.W. The region forms part of the Nepean-Warragamba catchment area, and may be considered under the headings of tablelands, level valleys, and canyons or deep gorges. The tablelands have a thick mantle of soil or are forested; they supply water permanently to the streams, areas of swamp lands acting as storage grounds. The level valleys, which vary in elevation from 300 ft. to 3100 ft. above sea-level, are in parts water-bearing, but they depend largely upon the tablelands for permanent streams. The sides of the steep gorges have a very quick run-off. The continued permanency of the streams will depend largely upon the preservation of upland swamps and forests.—(2) Goulburn, a vital point on the New South Wales Highlands. Goulburn is situated on the tablelands between two series of deep gorges. The main routes leading from Sydney to Riverina and the Southern Tablelands pass along a narrow strip of undissected country to Goulburn, whence there is a divergence of routes. These take advantage of gentle radial valleys converging on the town, which is, therefore, a natural centre for communications and trade.

Vienna.

Academy of Sciences, July 3.—**G. Koller** and **E. Kandler**: The constitution of cetraric acid.—**G. Koller** and **W. Passler**: The constitution of capraric acid.—**A. Franke** and **A. Kroupa**: Ring-contraction in the formation of inner ethers (oxides) from glycols (1, 5-oxido-dodecane from 1, 12-dodecanediol).—**A. Franke** and **A. Kroupa**: The preparation of α-alkyl-pimelinic acids from 1, 5-oxidodecane and 1, 5 oxido-dodecane. —**A. Haas**: (1) The mean mass-density of the universe. (2) The possible connexion between cosmic and physical constants.—**G. Nöbeling**: A fixed point theorem for curves connected *im Kleinen*.—**G. Nöbeling**: Universal curves of finite order.—**A. Wald**: Axiomatics of the concept 'between' in metrical spaces.—**K. Strubecker**: Helical lines in elliptical space.—**H. Leng**: The question of photographic activity of metals after exposure to sunlight. The author did not succeed in getting results reported by others.—**H. Brell**: The question of the linearity of the Lorentz transformation.

Washington, D.C.

National Academy of Sciences (*Proc.*, Vol. 16, No. 8, Aug. 15).—**G. A. Miller**: Groups which are decomposable into two non-invariant cyclic subgroups.—**Solomon Lefschetz** and **William W. Flexner**: On the duality theorems for the Betti numbers of topological manifolds.—**A. H. Sturtevant** and **T. Dobzhansky**: Reciprocal translocations in *Drosophila* and their bearing on *Œnothera* cytology and genetics. The suggestion that chromosome rings result from exchanges of ends between non-homologous chromosomes seems to apply to *Drosophila*.—**T. Elliot Weier**: Notes on the plastid and other cytoplasmic bodies during sporogenesis and spermatogenesis in *Polytrichum commune*. Previous to gametogenesis, the plastid assumes a form closely resembling a Golgi body.—**J. B. Conant** and **W. G. Humphrey**: The nature of the prosthetic group in *Limulus* hæmocyanin. A black material is obtained which contains copper and seems to be a complex salt of an amino acid containing sulphur.—**Lynn H. Dawsey**: The photochemical dissociation of nitrogen peroxide. Absorption spectra of nitrogen dioxide and tetroxide have been photographed at room temperature and at the temperature of liquid air. Primary photochemical decomposition of the mixture is due to the tetroxide and the threshold is at about 3800 A.—**J. B. Conant** and **F. H. Crawford**: The study of absorption spectra of organic compounds at liquid air temperatures. Absorption bands of porphyrins and similar coloured organic substances are resolved into finer lines at liquid air temperature.—**H. J. Schumacher**: A correction to "The Decomposition of Nitrogen Pentoxide at Low Pressures".

Official Publications Received.

BRITISH.

Journal of the Royal Microscopical Society. Series 3, Vol. 50, Part 3, September. Pp. xvi+297-385. (London.) 10s. net.

Journal of the Royal Statistical Society. New Series, Vol. 93, Part 4. Pp. 489-652+xiii. (London.) 7s. 6d.

Journal of the Chemical Society. September. Pp. iii+2037-2216+xii. (London.)

India: Meteorological Department. Scientific Notes, Vol. 2, No. 13: Atmospheric Instability of Agra associated with a Western Disturbance. By Dr. K. R. Ramanathan. Pp. 21-25+4 plates. 14 annas; 1s. 6d. Scientific Notes, Vol. 2, No. 14: Horizontal Atmospheric Visibility at Agra. By Barkat Ali. Pp. 27-36. 6 annas; 8d. (Calcutta: Government of India Central Publication Branch.)

Proceedings of the Royal Society of Edinburgh, Session 1929-1930. Vol. 50, Part 3, No. 19: On Radioactive Diffusion in the Atmosphere. By O. F. T. Roberts. Pp. 225-242. 1s. 6d. Vol. 50, Part 3, No. 20: Certain Quinoline and Benzacridine Derivatives yielding Coloured Adsorption Compounds with Iodine. By Dr. William Ogilvy Kermack, Dr. Robert Henry Slater and Walter Thomas Spragg. Pp. 243-261. 1s. 6d. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

Transactions of the Royal Society of Edinburgh. Vol. 56, Part 3, No. 27: The Old Red Sandstone of Shetland. Part 2: North-western Area. By Dr. T. M. Finlay. Pp. 671-694+3 plates. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.) 4s.

Royal Microscopical Society. List of Fellows, September 1930. Pp. 28. (London.)

Report of the Government Chemist upon the Work of the Government Laboratory for the Year ending 31st March 1930; with Appendices. Pp. 45. (London: H.M. Stationery Office.) 9d. net.

Annals of the Solar Physics Observatory, Cambridge. Vol. 2, Part 1: The Spectrum of β Lyrae. By F. E. Baxandall, under the direction of Dr. H. F. Newall, and later of F. J. M. Stratton. Pp. vi+24+3 plates. (Cambridge: At the University Press.)

Ceylon Journal of Science. Section B: Zoology and Geology. Spolia Zeylanica. Edited by Dr. Joseph Pearson. Vol. 16, Part 1, September 8th. Pp. 113+24 plates. (Colombo: Colombo Museum; London: Dulau and Co., Ltd.) 3 rupees.

Quarterly Journal of the Royal Meteorological Society. Vol. 56, No. 237, October. Pp. 359-432. (London: Edward Stanford, Ltd.) 7s. 6d.

The Phenological Report, 1929. Edited by a Committee of the Royal Meteorological Society. Thirty-ninth Report. Pp. 207-270. (London: Edward Stanford, Ltd.) 3s.

Education, India. Pamphlet No. 28: Revised Series of Mental Intelligence Tests for Indian Scholars. Pp. iv+32. (Calcutta: Government of India Central Publication Branch.) 7 annas; 9d.

Annual Report of the Director of the Meteorological Office presented by the Meteorological Committee to the Air Council for the Year ended March 31, 1930. (M.O. 328.) Pp. 55. (London: H.M. Stationery Office.) 1s. net.

Memoirs of the Geological Survey of India. Vol. 55, Part 1: The Geology of the Mergui District. By the late Rao Bahadur S. Sethu Rama Rau. Pp. iv+62+xxii+8 plates. (Calcutta: Government of India Central Publication Branch.) 6.2 rupees; 10s.

Allahabad University Studies. Vol. 1. Pp. iv+428. 7.8 rupees. Vol. 2. Pp. iv+362. 7.8 rupees. Vol. 3. Pp. vi+307. 7.8 rupees. Vol. 4. Pp. vi+489. 7.8 rupees. (Allahabad.)

Forest Department, Punjab. Punjab Forest Conference, Lahore, 1930: Proceedings, Resolutions and Papers. Pp. iv+73. (Lahore: Government Printing Office.)

Nyasaland Protectorate. Annual Report of the Geological Survey Department for the Year 1929. Pp. 11. (Zomba.)

Proceedings of the Royal Irish Academy. Vol. 39, Section B, Nos. 23, 24, 25: Diazotisation in the Pyrazole Series, by Dr. J. Reilly and D. MacSweeney; Xylan, by Dr. J. Reilly, P. P. Donovan and Miss K. Burns; A new Synthesis of substituted Thio-Xanthhydrols, by Dr. J. Reilly, Dr. P. J. Drumm and B. Daly. Pp. 497-522. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 1s.

The Dyestuffs Act: Views of the Chemical Industry. Pp. 24. (London: Association of British Chemical Manufacturers.)

Medical Research Council. Tenth Annual Report of the Industrial Health Research Board (formerly the Industrial Fatigue Research Board) to 31st December 1929. Pp. 29. (London: H.M. Stationery Office.) 6d. net.

Proceedings of the Royal Society. Series A, Vol. 129, No. A810, October 1. Pp. 235-410. (London: Harrison and Sons, Ltd.) 9s.

Nigeria. Annual Report on the Agricultural Department for the Year 1929. Pp. 20. (Lagos: C.M.S. Bookshop; London: The Crown Agents for the Colonies.) 2s.

The Journal of the Royal Horticultural Society. Edited by F. J. Chittenden. Vol. 55, Part 2, September. Pp. 169-304+lxvii-clxxxii+xx+52 plates. (London.) 7s. 6d.

East London College (University of London). Calendar, Session 1930-1931. Pp. 201. (London.) 1s.

The Royal Society of Tasmania: Papers and Proceedings, 1930. The Evolution of the Class Insecta. By Dr. R. J. Tillyard. Pp. 89. (Hobart.)

Memoirs of the Queensland Museum. Vol. 10, Part 1, August 28th. Edited by Heber A. Longman. Pp. 88+9 plates. (Brisbane.)

Air Ministry: Aeronautical Research Committee. Reports and Memoranda. No. 1317 (Ae. 454): Flight Tests on the Variation of the Range of an Aircraft with Speed and Height. By Flight-Lieut. C. E. Maitland and A. E. Woodward Nutt. (T. 2818.) Pp. 7+12 plates. 9d. net. No. 1325 (Ae. 459): A Study of Polynomial Equations. By W. L. Cowley and Sylvia W. Skan. (T. 2920.) Pp. 20+2 plates. 1s. net. No. 1329 (Ae. 461): Maximum Force on Rudders. By F. B. Bradfield. (T. 2960.) Pp. 4+12 plates. 6d. net. No. 1320 (Ae. 456): Controllability at Low Speeds and Full Scale Measurement of Lift and Drag of Parnall "Peto" fitted with R.A.F. 15 and R.A.F. 31 Section Wings (Slotted and Unslotted). By R. K. Cushing. (S. and C. 344.) Pp. 11+9 plates. 9d. net. (London: H.M. Stationery Office.)

FOREIGN.

Bulletin of the Earthquake Research Institute, Tôkyô Imperial University. Vol. 8, Part 3, September. Pp. 321-376. (Tôkyô: Iwanami Shoten.) 63 sen.

Journal of the Faculty of Science, Imperial University of Tokyo. Section 2: Geology, Mineralogy, Geography, Seismology. Vol. 2, Part 10. Pp. 399-418+plates 77-80. (Tokyo: Maruzen Co., Ltd.) 80 sen.

United States Department of the Interior: Geological Survey. Bulletin 813-A: Mineral Industry of Alaska in 1928 and Administrative Report. By Philip S. Smith. (Mineral Resources of Alaska, 1928-A.) Pp. ii+96+xiii. 15 cents. Bulletin 814: Geology and Ore Deposits of the Wood River Region, Idaho. By Joseph B. Umpleby, Lewis B. Westgate and Clyde P. Ross; with a Description of the Minnie Moore and Near-by Mines, by D. F. Hewett. Pp. xi+250+33 plates. 90 cents. Professional Paper 155: The Flora of the Denver and Associated Formations of Colorado. By Frank Hall Knowlton. A Posthumous Work edited by Edward Wilber Berry. Pp. vii+142+59 plates. 80 cents. Professional Paper 159: The Upper Cretaceous Floras of Alaska. By Arthur Hollick; with a Description of the Plant-bearing Beds, by George C. Martin. Pp. v+123+87 plates. 80 cents. Water-Supply Paper 634: Surface Water Supply of the United States, 1926. Part 12: North Pacific Slope Basins. C: Pacific Slope Basins in Oregon and Lower Columbia River Basin. Pp. vi+236. 25 cents. Water-Supply Paper 631: Surface Water Supply of the United States, 1926. Part 11: Pacific Slope Basins in California. Pp. ix+419. 65 cents. (Washington, D.C.: Government Printing Office.)

The Academy of Natural Sciences of Philadelphia. 1929 Year Book. Pp. 108+16 plates. (Philadelphia, Pa.)

Proceedings of the Academy of Natural Sciences of Philadelphia. Vol. 81, 1929. Pp. iii+689+23 plates. (Philadelphia, Pa.) 6.25 dollars.

Proceedings of the American Philosophical Society. Vol. 69, No. 6. Pp. 295-396. (Philadelphia, Pa.)

Conseil Permanent International pour l'Exploration de la Mer. Rapports et procès-verbaux des réunions. Vol. 66: Procès-verbaux (mai-juin 1930). Pp. 163. 6.25 kr. Bulletin hydrographique pour l'année 1929. Pp. 118. 6.25 kr. (Copenhague: Andr. Fred. Høst et fils.)

Państwowa Rada Ochrony Przyrody. Wydawnictwo Okręgowego Komitetu Ochrony Przyrody na Wielkopolskę i Pomorze w Poznaniu. Zeszyt 1. Pp. 48. Monografje Naukowe, Nr. 1: Lasy Białowieży (Die Waldtypen von Białowieża). By Józef Paczoski. Pp. 575. (Kraków: Państwowa Rada Ochrony Przyrody.)

CATALOGUES.

The Nickel Bulletin. Vol. 3, No. 10, October. Pp. 313-344. (London: The Mond Nickel Co., Ltd.)

Radiostol, Irradiated Ergosterol: the Original British Standardised Vitamin D. Pp. 15. (London: The British Drug Houses, Ltd.)

Diary of Societies.

FRIDAY, OCTOBER 31.

INSTITUTION OF ELECTRICAL ENGINEERS (West Wales (Swansea) Sub-Centre) (at Corporation Electricity Showrooms, Swansea), at 6.—Sir A. Whitten Brown: Chairman's Address.

INSTITUTION OF ELECTRICAL ENGINEERS (London Students' Section), at 6.15.—H. T. Young: Is the Engineer of To-day making the Best Use of his Opportunities in Electrical Development in this Country?

INSTITUTION OF CHEMICAL ENGINEERS (at Institution of Civil Engineers), at 6.30.—Prof. W. A. Bone: High-Pressure Reactions (Lecture).

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY (Chemical Section), at 7.

SOCIETY OF CHEMICAL INDUSTRY (Glasgow Section) (at St. Enoch Station Hotel, Glasgow), at 7.30.—Dr. S. Miall: Editorial Notes on the Journal of the Society.

JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7.30.—E. T. Westbury: The Two-stroke Engine.

GEOLOGISTS' ASSOCIATION (in Great Hall, University College), at 7.30.—Annual Conversazione.

INSTITUTE OF BREWING (at South-Western Hotel, Southampton).—A. Hadley: Some Aspects of Bottling.—H. L. Hind: Some Aspects of the Research Work.

IMPERIAL COLLEGE CHEMICAL SOCIETY (in Main Chemistry Lecture Theatre, Royal College of Science).—Prof. J. F. Thorpe: The Life and Work of W. H. Perkin, Junr.

MEDICAL SOCIETY OF LONDON.—Sir Almroth Wright and others: Discussion on The Prophylactic and Therapeutic Values of Vaccines.

INSTITUTE OF CHEMISTRY (Birmingham and Midlands Section) (at Grand Hotel, Birmingham).—R. B. Pilcher and others: Discussion on Co-operation.

MONDAY, NOVEMBER 3.

ROYAL SOCIETY OF EDINBURGH, at 4.30.—Dr. P. Eggleton: On Recent Work in the Biochemistry of Muscle.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.—General Meeting.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—D. H. Patey: Demonstration of Specimens illustrating the Pathological Conditions of the Salivary Grands.

SOCIETY OF ENGINEERS (at Geological Society), at 6.—H. B. Millard: The Measurement of Water.

INSTITUTION OF ELECTRICAL ENGINEERS (Mersey and North Wales (Liverpool) Centre) (at University, Liverpool), at 7.—H. A. Humphrey, D. M. Buist, and J. W. Bansall: The Steam and Electric Power Plant of Imperial Chemical Industries, Ltd., at Billingham.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—Prof. F. J. M. Stratton: Solar Eclipse Photography.

INSTITUTION OF AUTOMOBILE ENGINEERS (Glasgow Centre) (at Institution of Engineers and Shipbuilders, Glasgow), at 7.30.—Sir Herbert Austin: The Future Trend of Automobile Design (Presidential Address).

HUDDERSFIELD TEXTILE SOCIETY (at Technical College), at 7.30.—B. G. B. Slocombe: The Properties and Uses of Celanese.

SOCIETY OF CHEMICAL INDUSTRY (London Section) (at Burlington House), at 8.—Prof. F. J. Spencer: Magnetic Susceptibility as a Means of Investigating Chemical Properties.—Dr. R. C. Farmer: The Mechanism of the Formation of Cellulose Nitrate and Other Nitric Esters.

INSTITUTION OF ELECTRICAL ENGINEERS (Western Centre) (at Cardiff).

TUESDAY, NOVEMBER 4.

ROYAL SOCIETY OF MEDICINE (Orthopædics Section), at 5.—J. Verrall: Some Amputation Problems (Presidential Address).

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. W. E. Hume: Paroxysmal Tachycardia (Bradshaw Lecture).

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Dr. C. D. Ellis: New Aspects of Radioactivity (1).

MINERALOGICAL SOCIETY (Anniversary Meeting), at 5.30.—A. Russell: An Account of British Mineral Collectors in the 17th, 18th, and 19th Centuries.—M. H. Hey: Cupriferous Melanterite from the Skouriotissa Mine, Cyprus.—Dr. C. E. Tilley: (*a*) The Dolerite-chalk Contact-zone of Scawt Hill, Co. Antrim; (*b*) The Production of Basic Alkali-rocks by the Assimilation of Limestone by Basaltic Magma: with Chemical Analyses by Dr. H. F. Harwood.—Dr. F. Smithson: A Simple Method of Observing the Magnetic Properties of Mineral Grains.

ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—W. B. Cotton: Exhibition of Ears and Molars of an African Elephant.—Secretary: Exhibition of Photographs of Elephants taken by Mr. M. A. Wetherall in the Belgian Congo.—J. R. Norman: Exhibition of Photographs of a Living Shark with a Remora attached.—D. Aubertin, A. E. Ellis, and G. C. Robson: The Natural History and Variation of the Pointed Snail, *Cochlicella acuta*.—B. J. Marples: The Proportions of Birds' Wings and their Changes during Development.—A. G. Lowndes: On Entomostraca from the New Hebrides collected by Dr. J. R. Baker.—H. W. Parker: A Collection of Frogs from Portuguese East Africa.

INSTITUTION OF CIVIL ENGINEERS, at 6.—Sir George William Humphreys: Presidential Address.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—The Oleobrom Process.

SOCIETY OF CHEMICAL INDUSTRY (Nottingham Section) (at University College, Nottingham), at 7.30.—Dr. R. H. Pickard: Some Applications of Chemistry and Physics to the Examination of Hosiery Yarns.

INSTITUTE OF METALS (North-East Coast Local Section) (in Armstrong College, Newcastle-upon-Tyne), at 7.30.—S. L. Archbutt: Gases in Metals.

WEDNESDAY, NOVEMBER 5.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.

INSTITUTION OF ELECTRICAL ENGINEERS (Wireless Section), at 6.—C. E. Rickard: Chairman's Inaugural Address.

LIVERPOOL ENGINEERING SOCIETY (at 9 The Temple, Liverpool), at 6.30.—C. H. Faris: The Application of Electro-deposited Metals to Marine Engineering.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (at 20 Hart Street, W.C.1), at 7.—T. G. N. Haldane: The Operation of the Heat Pump and its Possible Application to Heating Problems, particularly Swimming Bath Heating.

SOCIETY OF GLASS TECHNOLOGY (London Section) (at Holophane, Ltd., Elverton Street, S.W.1), at 7.30.—Discussion on The Etching of Glass: —Dr. S. English: Introductory Remarks.—E. A. Coad-Pryor: Etching of Bottles.—A. L. Marden: Etching of Lamp Bulbs.—E. Jacobs: Etching of Scientific Glassware.

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS (at Chemical Society), at 8.—P. Arup: The Analysis and Composition of Vegetable Parchment used for Packing Dairy Products.—Dr. G. M. Moir: The Determination of the Milk Proteins.—Dr. S. G. Clarke: The Lead Reduction Method for the Volumetric Determination of Tin, and the Interference of Copper and Antimony.—W. J. Agnew: A New Method for Determining Traces of Chromium in Steel.

ROYAL SOCIETY OF ARTS, at 8.30.—Sir Edward Gait: Britain's Record in India (Inaugural Address).

ROYAL SOCIETY OF MEDICINE (Surgery Section), at 8.30.—C. H. Fagge: Presidential Address.

ROYAL MICROSCOPICAL SOCIETY (Biological Section) (at B.M.A. House, Tavistock Square, W.C.).

THURSDAY, NOVEMBER 6.

ELECTRICAL ASSOCIATION FOR WOMEN (at 15 Savoy Street, W.C.2), at 3.—Miss Beatrice Irwin: The New Art of Illumination.

ROYAL SOCIETY, at 4.30.—Prof. W. A. Bone and S. G. Hill: The Slow Combustion of Ethane.—Prof. A. M. Tyndall and C. F. Powell: The Mobility of Ions in Pure Gas.—A. Fage and W. M. Falkner: An Experimental Determination of the Intensity of Friction on the Surface of an Aerofoil.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Prof. G. E. Gask: Vicary's Predecessors (Thomas Vicary Lecture).

IMPERIAL COLLEGE CHEMICAL SOCIETY (in Main Chemistry Lecture Theatre, Royal College of Science), at 5.10.—Dr. F. W. Aston: Mass Spectra and Packing Fractions (Lecture).

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Prof. J. B. S. Haldane: The Physiology of Water (1).

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—D. B. Hoseason: The Cooling of Electrical Machines.

INSTITUTION OF AUTOMOBILE ENGINEERS (Bristol Centre) (at Merchant Venturers' Technical College, Bristol), at 7.—J. Bradley and S. A. Wood: Some Experiments on the Factors affecting the Motion of a Four-wheeled Vehicle when some of its Wheels are locked.—J. Bradley and R. F. Allen: Factors affecting the Behaviour of Rubber Tyred Wheels on Road Surfaces.—A. H. Girling: A New Automobile Braking System.

SOCIETY OF CHEMICAL INDUSTRY (Manchester Section) (jointly with Manchester Sections of the Manchester Literary and Philosophical Society, British Association of Chemists, Institute of Chemistry, Institute of Fuel, Institution of the Rubber Industry, Oil and Colour Chemists' Association, Society of Dyers and Colourists, and Institution of Electrical Engineers) (at College of Technology, Manchester), at 7.—Sir William B. Hardy: Paper.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Western Centre) (jointly with North-Western Centre of Institution of Mechanical Engineers) (at College of Technology, Manchester), at 7.—K. Baumann: Some Considerations in the Future Development of the Steam Cycle.

SOCIETY OF CHEMICAL INDUSTRY (Bristol Section) (at Bristol University), at 7.30.—R. F. Taylor: Glass and Glass Making, with Reference to Special Glasses.

ROYAL SOCIETY OF MEDICINE (Tropical Diseases Section), at 8.—Dr. E. C. Smith: Cultivation of the Spirochætes associated with Tropical Ulcer.

TEXTILE INSTITUTE (Irish Section) (at Belfast).—A. J. Hall: Properties of Artificial Silk as affecting Industrial Uses.

FRIDAY, NOVEMBER 7.

ROYAL SOCIETY OF ARTS (Indian Section), at 4.30.—Sir T. Vijayaraghavacharyar: The Work of the Imperial Council of Agricultural Research.

ROYAL SOCIETY OF MEDICINE (Laryngology Section), at 5.—Dr. E. Sheehan: Cinematograph Demonstration.—Dr. Chevalier Jackson and others: Discussion on Precancerous Conditions of the Larynx.

PHYSICAL SOCIETY (at Imperial College of Science and Technology), at 5.—Dr. W. N. Bond: Turbulent Flow through Tubes.—J. S. Rogers: The Photographic Effects of Gamma-Rays.—J. S. Badami: The Spectrum of Trebly Ionised Cerium (Ce IV).—Prof. S. Chapman: The Absorption and Dissociative or Ionising Effect of Monochromatic Radiation in an Atmosphere on a Rotating Earth.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: Demonstration of Specimens of Surgical Interest recently added to the Museum of the Royal College of Surgeons.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Prof. J. W. Gregory: The Machinery of the Earth (Thomas Hawksley Lecture).

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Mining Institute, Newcastle-upon-Tyne), at 6.—R. W. Allen: Feed-Water Systems for Steam Installations.

INSTITUTION OF ELECTRICAL ENGINEERS (Meter and Instrument Section), at 7.—E. Fawssett: Chairman's Inaugural Address.

OIL AND COLOUR CHEMISTS' ASSOCIATION (Manchester Section, jointly with other Manchester Scientific Societies) (at Milton Hall, Manchester), at 7.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group), at 7.—Informal Meeting.

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (jointly with Institute of Chemistry, South Wales Section) (at Thomas' Café, Swansea), at 7.30.—A. Stuart: The Study of Crystals with Special Reference to Chemistry.

JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7.30.—H. Marryat: Luminous Electric Tubes (Neon, Helium).

SATURDAY, NOVEMBER 8.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—A. Hamilton Smith: Some Recent Archæological Work in Italy (1).

PUBLIC LECTURES.

SATURDAY, NOVEMBER 1.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—D. Martin Roberts: London in the Stuart Age.

TUESDAY, NOVEMBER 4.

KING'S COLLEGE, LONDON, at 11 A.M.—S. P. Turin: The Economic Geography of U.S.S.R.: Russian Farming and Agriculture.

UNIVERSITY COLLEGE, at 5.30.—Miss M. A. Murray: Egyptian Statues.

UNIVERSITY OF CAMBRIDGE, at 5.30.—Sir James Jeans: The Mysterious Universe (Rede Lecture).

MEMORIAL HALL (Farringdon Street).—Sir George Newman: How England learned to control Disease.

WEDNESDAY, NOVEMBER 5.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Prof. S. L. Cummins: The Prevention of Tuberculosis.

UNIVERSITY COLLEGE, LONDON, at 5.30.—I. C. Gröndahl: Norway, the Land and the People. (Succeeding Lectures on Nov. 12 and 19.)

LONDON SCHOOL OF ECONOMICS AND POLITICAL SCIENCE, at 6.—Dr. M. Culpin: Modern Views of Nervous Troubles. (Succeeding Lectures on Nov. 12 and 19.)

THURSDAY, NOVEMBER 6.

KING'S COLLEGE, LONDON, at 3.—C. J. Gadd: Babylonian Religion.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Dr. Marie C. Stopes: History and Theory of Contraceptive Technique.

ROYAL SOCIETY OF MEDICINE (in Barnes Hall), at 5.—V. E. Negus: Some Observations on Semon's Law (Semon Lecture).

BEDFORD COLLEGE FOR WOMEN, at 5.15.—Dr. H. Clay: Economic Responsibility.

BRITISH MEDICAL ASSOCIATION (in Hastings Hall, Tavistock Square), at 5.15.—Dr. M. Ray: The Treatment of Rheumatism (Chadwick Lecture).

MEMORIAL HALL (Farringdon Street).—Sir George Newman: Health Problems of the Modern Period.

SATURDAY, NOVEMBER 8.

MATHEMATICAL ASSOCIATION (at Bedford College for Women), at 3.—A. H. Russell: Some Methods of Lightning Calculation.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—M. A. Phillips: Animal Childhood.

CONGRESS.

NOVEMBER 1 AND 2.

INSTITUTE OF SOCIOLOGY (at Imperial Institute).—Lectures and Discussions on Sociological and Survey Topics.